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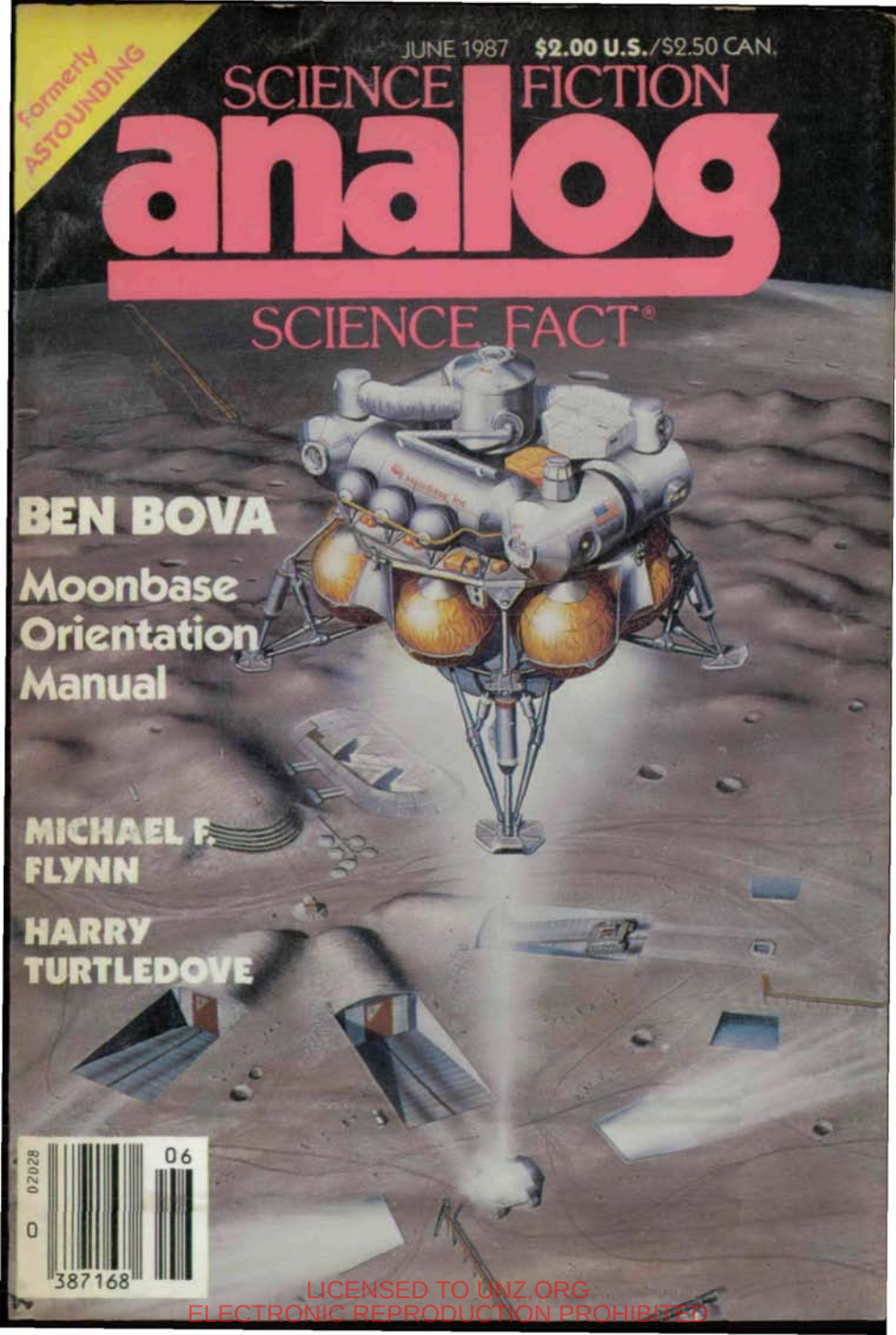

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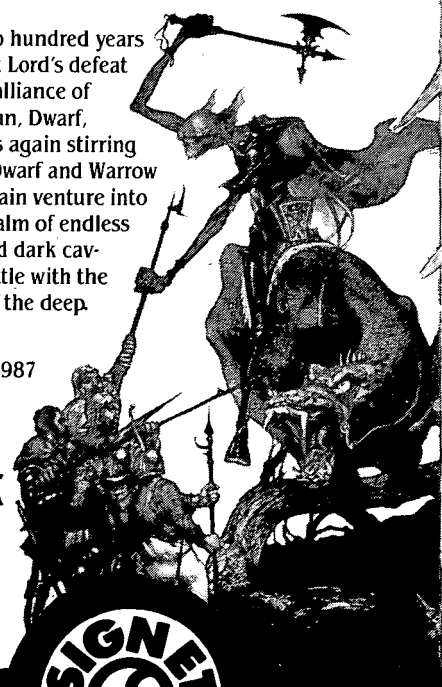

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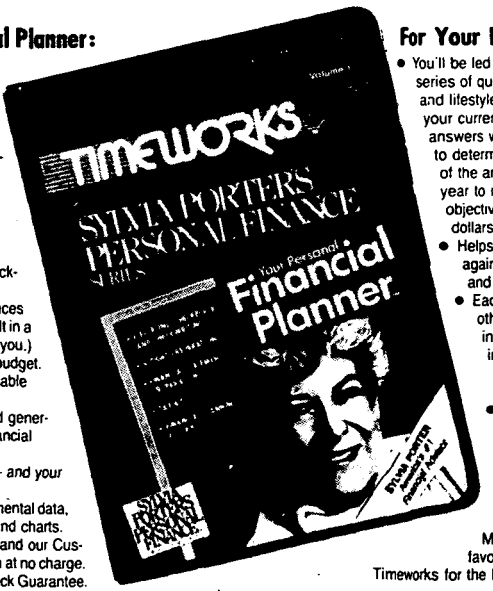

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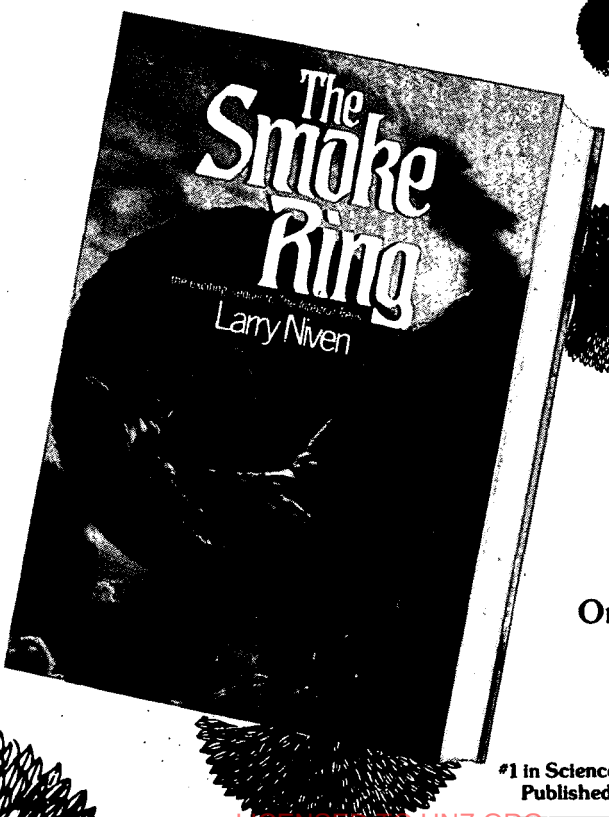

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Editorial

CHILD ABUSE

Stanley Schmidt

Some of the wording was interesting, to say the least. You've heard about it, whether through radio or television, newspapers or magazines: the case last fall in which U.S. District Judge Thomas G. Hull, without a jury, ruled that the public schools in Hawkins County, Tennessee, must provide for alternative forms of reading instruction for the children of parents who object to their reading such evil, pernicious mindrot as *The Wizard of Oz*, *The Diary of Anne Frank*, and various writings of Hans Christian Andersen, Margaret Mead, and Isaac Asimov. Not surprisingly, many reporters and commentators called it a new Scopes trial, comparing it to the 1925 trial in which John Scopes was prosecuted by the state (Tennessee, again) for teaching Darwin's theory of evolution; but that's not what I found most interesting about the wording in the reports I saw. What I found most interesting was the rampant confusion about whose rights were being protected.

I have several articles on the subject in front of me as I write. One says the judge ruled that, "Fundamentalist Christian children have the right not to read schoolbooks their parents find offensive. . . ." Another says he ruled that parents "could protect their children from those assigned schoolbooks that offended their religious beliefs," and that children could " 'opt out' of class if their beliefs are offended by the class texts."

Now—does anybody really believe many of those *children* are being given much choice as to how to "opt"? Even

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if they were, I question how wise that would be, either for them or for the civilization they will soon inherit. Few of them have yet been exposed to enough ideas to be in a good position to choose among them. That's why they're in school—but their parents want to make sure they *aren't* exposed to other ideas. It's their *parents*' "right" to decide that's being protected—and imposed on their children whether they want it or not. (Yes, I know that if you asked them, many would say they do. But how many would feel free to say anything else? And even if they really *believe* they prefer it this way, how valid is a preference formed after seeing only one choice?) The children are being guaranteed the "right" not to read schoolbooks their parents find offensive—but how about the right to read them if *they* want to? Whether the children opt out is not going to be determined by whether *their* beliefs are offended, but by whether their *parents*' beliefs are offended—while the children are denied the opportunity to form an intelligent set of their own.

Now, with all the respect I can muster, I seriously question whether this is doing the children any favors. In case that sounds too sarcastic, let me add that I *can* muster *some* respect for the parents' position. I, too, have reservations about the quality of some public education. I am very much in favor of parents' having input into public curriculum development, the option of putting their children into private schools (at their own expense) if they prefer, and even of educating their children entirely at home if they prefer and are qualified. But I don't think they, any more than professional teachers or boards of education, should be allowed to do absolutely anything they choose, no matter how irresponsible, in the name of education—because I would like all children to have access to a *good* education, no matter where or how they get it. I don't see jamming an ideology down someone's throat—*any* ideology—as good education. And that's what you're doing when you don't let a student see any ideology but the one you think he should have. What the Tennessee plaintiffs and their sympathizers see as "protecting" the children from dangerous beliefs, I see as denying them the opportunity to learn to make intelligent choices.

That's what good education is. It is not saying, "This is Right and you mustn't even *think* about anything else!" Nor is it saying, "Nothing is right or wrong and it doesn't matter what you think or do." Sadly, many people seem incapable of grasping that there exists a wide range of middle ground—and that sane, constructive philosophies for living are more likely to be found there than at either extreme. The best teachers and parents I've known have said things like, "This is fact, and here is why we think so. This is my opinion, and here is why I hold it. Think about what I say, and what everyone else you meet says, and figure out what *you* believe —carefully, because that's what you're going to have to live by."

Do the parents who want to "protect" their children from so much have so little faith in the strength of their own

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ideologies that they don't think they can withstand open competition from others? If so, how sad . . .

I have been fortunate enough to see really good education at work in quite a few cases—the kind that enables its recipients to live lives judged worthwhile and well spent both by themselves and by others whose lives they touch. With luck, they might even achieve lives approximating the best possible —for *them*, not for somebody else. But education has seldom, if ever, done this either by hiding all viewpoints but one, or by pretending all viewpoints are equally valid. It has done it by not only allowing but encouraging free access to an essentially unlimited range of information, ideas, opinions, and values, along with open, unfettered discussion of their relative merits and defects—and the good example of a life successfully

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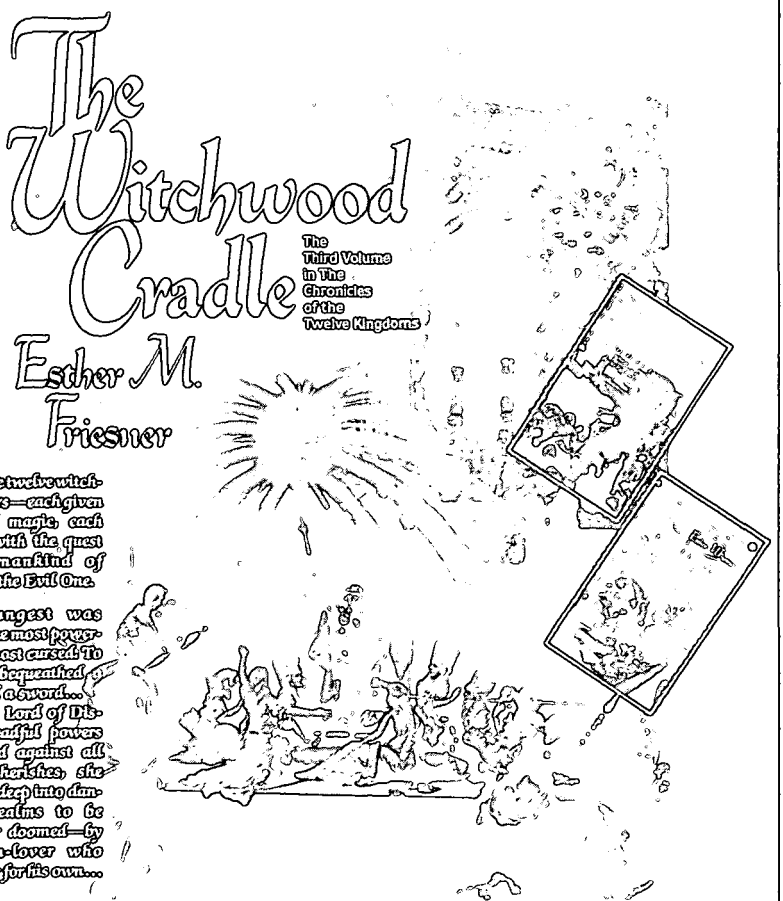
D THE WITCHBORN...



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lived. Given all that, a child has a pretty good chance of growing up able to make sensible and ethical decisions of his own. More than that I can't offer—and neither can anyone else I've met.

The kind of galloping censorship that seems to be coming back into fashion, as exemplified in the Tennessee decision, offers far less. Hiding behind the noble guise of "protecting" children, it actually severely limits the resources they have at their disposal to shape their own lives. I realize the parents quite sincerely believe that's nonsense, and that they have the Only True Way—but if their way is really so superior to all others, why not let the children see that for themselves. after seeing how it compares?

I am most reluctant to tell parents how to raise their children, or to condone allowing governments to do so. Such a course brings with it such dangers that it should be undertaken only as a last resort and with the greatest caution—but there is plenty of precedent for doing it in particular cases, some of them for reasons few could quarrel with. It would be very difficult to find a sane person willing to tolerate infanticide these days, and in fact present society is quite intolerant of far lesser abuses than that. "Child abuse" is currently one of the most fashionable of Causes; like many others, it started as a legitimate and important concern and has led to bizarre excesses which have left many parents and especially teachers afraid even to do some of the things they *should* be doing. Overzealous excesses notwithstanding, most civilized people would agree that *real* child abuse, in whatever form, is one of the more reprehensible kinds of activity, and justifies some intervention from without. Even people with a morbid dread of police states can feel good about calling the local gendarmes to stop a neighbor who is physically torturing and maiming a child.

I submit that crippling children intellectually, however unintentionally, is one of the cruelest forms of child abuse—and just may warrant authorizing a teacher to offer at least a modicum of balanced education to prevent it.

That is, after all, what he was hired to do—and an amateur who hires a professional to do a job and then tries to tell him how to do it cannot expect professional results. Car repair shops seldom allow customers in the work area, for several good reasons, and few people are stupid enough to try to tell their surgeons how to do an operation. Teaching is a profession, too, and deciding *what* to teach is an important part of it. Parents who decide to use the public school system should either get out of the way and let it do its job, or take their business elsewhere.*

This case will be appealed, but in the face of current trends I can't be too optimistic about the outcome. Meanwhile, before the book banners get too much farther, let me recommend one book that should be read Real Soon by just about everyone who hasn't yet read it—*especially* kids who are being "protected" from it in school, and parents who are "protecting" them from it! Sinclair Lewis wrote it in 1935, and it's called *It Can't Happen Here*. Its point,

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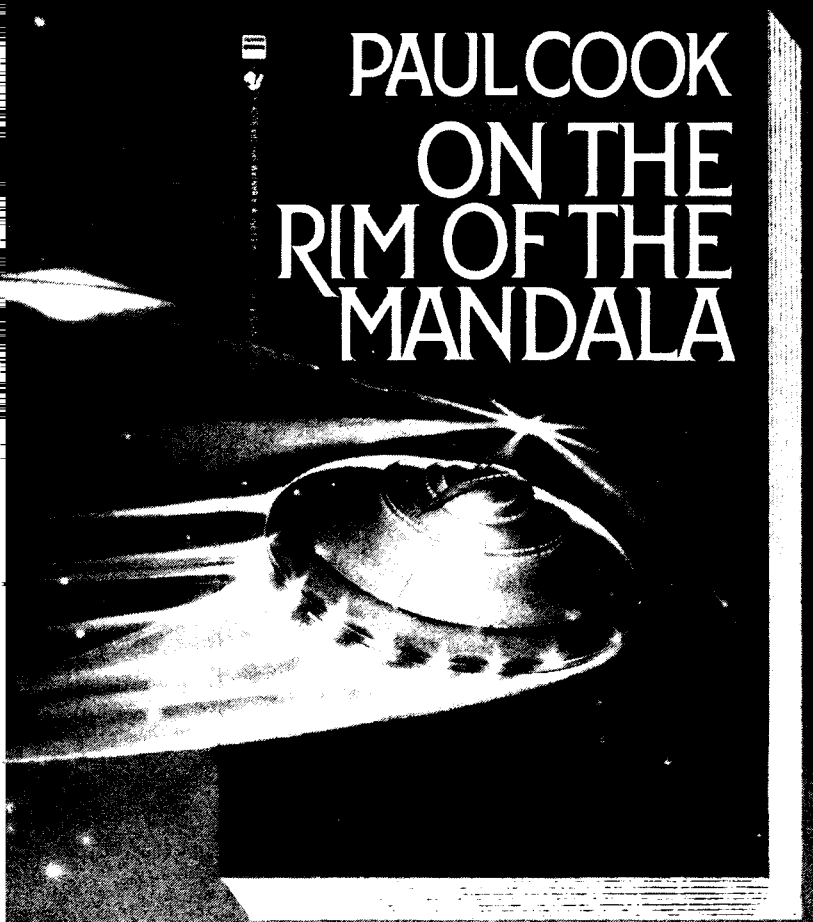
For what would an immortal risk everything?

PAUL COOK
ON THE RIM OF THE MANDALA



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of course, is that it can—and it's been a long time since the social climate has looked so ripe for it as it does right now. ■

*Yes, I know I said earlier that parents deserved input into curriculum development. I did *not* say they should have sole discretion or even the last word—and in any case, curriculum *development* is quite different from individual parents' deciding which parts of the curriculum they will accept or reject *after* it's developed and operating.

Clarion Writers Workshop celebrates its twentieth anniversary this year. The workshop, which Robin Scott Wilson started at Clarion College in Pennsylvania, has produced many of the current names in science fiction. George Alec Effinger, Vonda McIntyre, Octavia Butler, Kim Stanley Robinson and Bruce Sterling were all Clarion graduates.

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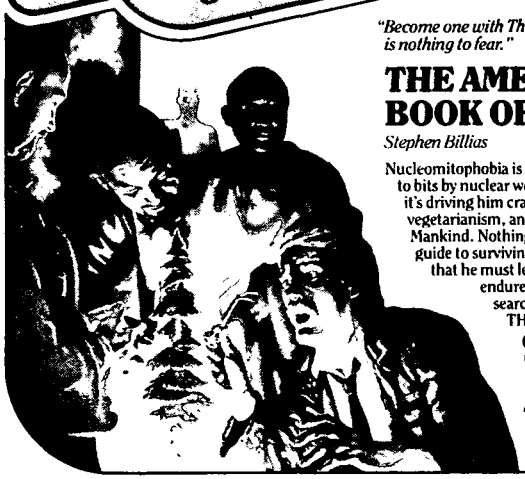

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Laurence M. Janifer

TELEPHONE

And it came to pass that the Archangel Gabriel called William Bryznycki on the telephone at four o'clock in the morning. And Bryznycki, who was a lot more than half asleep, fumbled around and picked up the receiver on the fifth ring and said: "Yuh?"

And the Archangel Gabriel informed Bryznycki that the world was going to come to an end at exactly 6:35 in the morning of that same day. And Bryznycki said: "What is this? Some kind of practical joke, right?"

"This is not a practical joke," Gabriel said.

"Who you kiddin'?" Bryznycki said. "Look, it's too goddamn late for stuff like that. I dunno about you, but I got to be at work, on the line, at nine."

"You do not," Gabriel said. "At 6:35 exactly—"

"Sure, buddy," Bryznycki said. "The bars close, so you got nothin' better to do, so you phone people like a nut. Well, listen to me—"

"Apparently you require some convincing," Gabriel said. "Look out your window."

Bryznycki could look out of his window without leaving the phone, or his bed. He shrugged and sighed and did so. And there was suddenly a multitude of the Heavenly Host, giving thanks and singing:

"*Dies irae, dies illa: solve saeclum in favilla,*"

Which was followed by an English translation of no particular merit.

When the Host had gone, Gabriel's voice was audible in the receiver. Bryznycki said: "Yeah? Yeah? Okay, I believe you. Holy God. I mean—well, okay. I believe you."

"The world will end at 6:35 this morning," Gabriel said.

Bryznycki nodded and said: "Sure," and then he frowned. "So why tell me?"

Gabriel said: "I am telling everyone. It is necessary that everyone know this."

Bryznycki said: "Look, buddy. Whatever. I mean, I don't care who you are, an angel or what. It's—4:05 now. You got an hour and a half to call everybody inna world. I don't care who you are, what you are, buddy—you can't do it. It can't be done. I mean, you know how many phone calls—"

"You do not understand," Gabriel said. "I want you to call five people. . . ." ■

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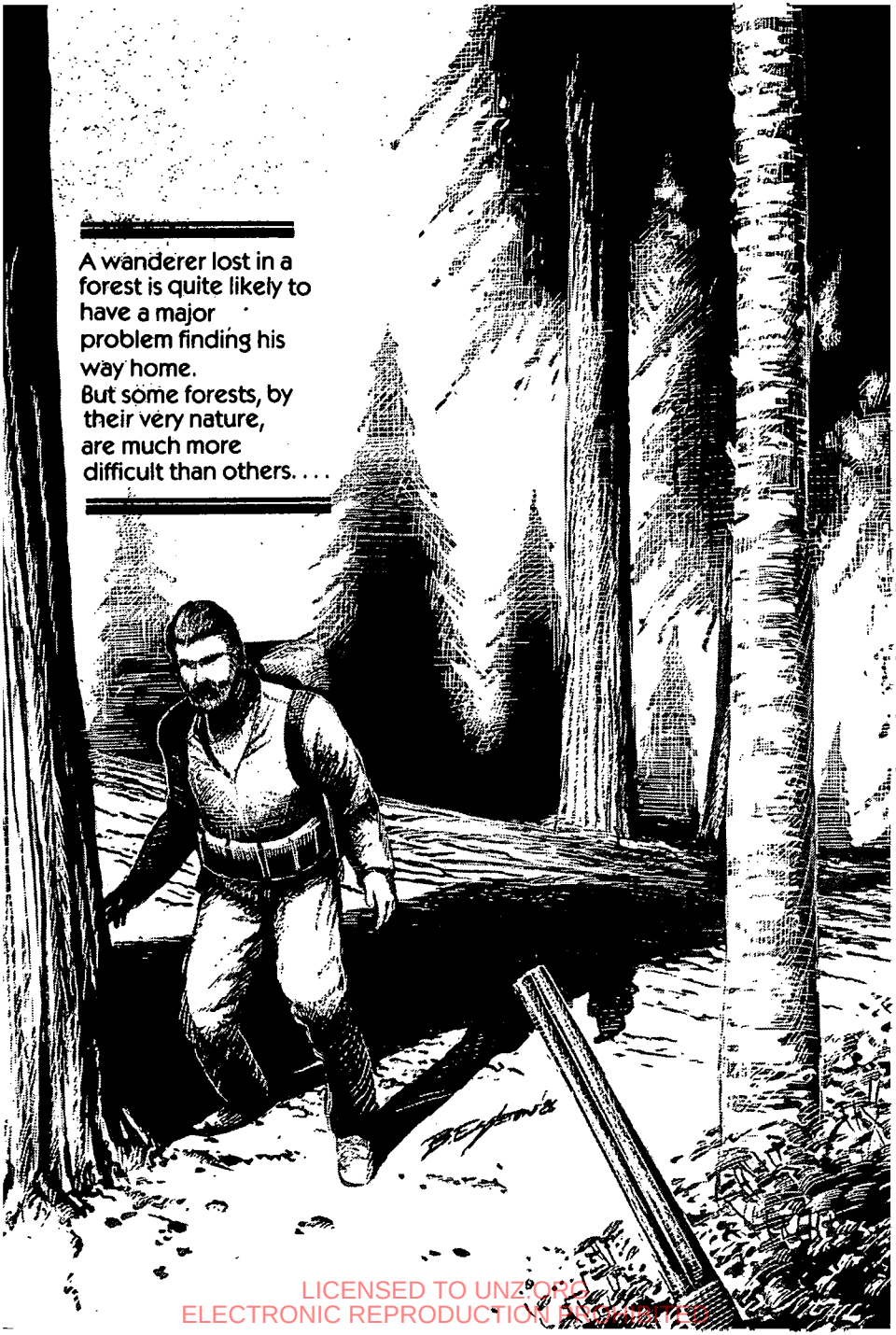
A wanderer lost in a forest is quite likely to have a major problem finding his way home.
But some forests, by their very nature, are much more difficult than others. . . .

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Michael F. Flynn

THE FOREST OF TIME

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It was the autumn of the year and the trees were already showing their death-colors. Splashes of orange and red and gold rustled in the canopy overhead. Oberleutnant Rudolf Knecht, Chief Scout of the Army of the Kittatinny, wore the same hues mottled for his uniform as he rode through the forest. A scout's badge, carefully rusted to dullness, was pinned to his battered campaign cap.

Knecht swayed easily to the rhythm of his horse's gait as he picked his way up the trail toward Fox Gap Fortress. He kept a wary eye on the surrounding forest. Periodically, he twisted in the saddle and gazed thoughtfully at the trail where it switchbacked below. There had been no sign of pursuit so far. Knecht believed his presence had gone undetected; but even this close to home, it paid to be careful. The list of those who wanted Knecht dead was a long one; and here, north of the Mountain, it was open season on Pennsylvanians.

There were few leaves on the forest floor, but the wind gathered them up and hurled them in mad dances. The brown, dry, crisp leaves of death. Forerunners of what was to be. Knecht bowed his head and pulled the jacket collar tighter about his neck.

Knecht felt the autumn. It was in his heart and in his bones. It was in the news he carried homeward. Bad news even in the best of times, which these were not. Two knick regiments had moved out of the Hudson Valley into the Poconos. They were camped with the yankees. Brothers-in-arms, as if last spring's fighting had never happened. General Schneider's fear: New York and Wyoming had settled their quarrel and made common cause.

Common cause. Knecht chewed on his drooping moustache, now more grey than brown. No need to ask the cause. There was little enough that yanks and knicks could agree on, but killing Pennsylvanians was one.

He remembered that General Schneider was inspecting the fortress line and would probably be waiting for him at Fox Gap. He did not feel the pleasure he usually felt on such occasions. *Na, Konrad, meiner Alt*, he thought. What will you do now? What a burden I must lay upon your shoulders. God help the Commonwealth of Pennsylvania.

He pulled in on the reins. There was a break in the trees here and through it he could see the flank of Kittatinny Mountain. A giant's wall, the ridge ran away, straight and true, becoming bluer and hazier as its forested slopes faded into the distance. Spots of color decorated the sheer face of the Mountain. Fox Gap, directly above him, was hidden by the forest canopy; but Knecht thought he could just make out the fortresses at Wind Gap and Tott Gap.

As always, the view comforted him. There was no way across the Kittatinny, save through the Gaps. And there was no way through the Gaps.

Twenty years since anyone has tried, he thought. He kicked at the horse and they resumed their slow progress up the trail. Twenty years ago; and we blew the knick riverboats off the water.

That had been at Delaware Gap, during the Piney War. Knecht sighed. The Piney War. It seemed such a long time ago. A different world; more innocent, somehow. Or perhaps he had only been younger. He remembered how he had marched away, his uniform new and

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sharply creased. Adventure was ahead of him, and his father's anger behind. I am too old for such games, he told himself. I should be sitting by the fire, smoking my pipe, telling stories to my grandchildren.

He chewed again on his moustache hairs and spit them out. There had never been any children; and now, there never would be. He felt suddenly alone.

Just as well, he thought. The stories I have to tell are not for the ears of youngsters. What were the stories, really? A crowd of men charged from the trench. Later, some of them came back. What more was there to say? Once, a long time ago, war had been glamorous, with pageantry and uniforms to shame a peacock. Now it was only necessary, and the uniforms were the color of mud.

There was a sudden noise in the forest to his right. Snapping limbs and a muffled grunt. Knecht started, and chastised himself. A surprised scout is often a dead one as well. He pulled a large bore pistol from his holster and dismounted. The horse, well-trained, held still. Knecht stepped into the forest and crouched behind a tall birch tree. He listened.

The noise continued. Too much noise, he decided. Perhaps an animal?

Then he saw the silhouette of a man thrashing through the underbrush, making no attempt at silence. Knecht watched over his gunsight as the man blundered into a stickerbush. Cursing, the other stopped and pulled the burrs from his trousers.

The complete lack of caution puzzled Knecht. The no-man's-land between Pennsylvania and the Wyoming was no place for carelessness. The other was either very foolish or very confident.

The fear ran through him like the rush of an icy mountain stream. Perhaps the bait in a trap; something to hold his attention? He jerked round suddenly, looking behind him, straining for the slightest sign.

But there was nothing save the startled birds and the evening wind.

Knecht blew his breath out in a gust. His heart was pounding. *I* am *getting too old for this*. He felt foolish and his cheeks burned, even though there was no one to see.

The stranger had reached the trail and stood there brushing himself off. He was short and dark complexioned. On his back he wore a rucksack, connected by wires to a device on his belt. Knecht estimated his age at thirty, but the unkempt hair and beard made him look older.

He watched the man pull a paper from his baggy canvas jacket. Even from where he crouched, Knecht could see it was a map, handsomely done in many colors. A stranger with a map on the trail below Fox Gap. Knecht made a decision and stepped forth, cocking his pistol.

The stranger spun and saw Knecht. Closer up, Knecht could see the eyes bloodshot with fatigue. After a nervous glance at the scout's pistol, the stranger smiled and pointed to the map. "Would you believe it?" he asked in English. "I think I'm lost."

Knecht snorted. "I would not believe it," he answered in the same language. "Put in the air your hands up."

The stranger complied without hesi-

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tation. Knecht reached out and snatched the map from his hand.

"That's a Pennsylvania Dutch accent, isn't it?" asked his prisoner. "It sure is good to hear English again."

Knecht looked at him. He did not understand why that should be good. His own policy when north of the Mountain was to shoot at English-speaking voices. He gave quick glances to the map while considering what to do.

"Are you hunting? I didn't know it was hunting season."

The scout saw no reason to answer that, either. In a way, he *was* hunting, but he doubted the prisoner had meant it that way.

"At least you can tell me where in the damn world I am!"

Knecht was surprised at the angry outburst. Considering who held the pistol on whom, it seemed a rash act at best. He grinned and held up the map. "Naturally, you know where in the damn world you are. While you have this map, it gives only one possibility. You are the spy, *nicht wahr?* But, to humor you . . ." He pointed northward with his chin. "Downtrail is the Wyoming, where your Wilkes-Barre masters your report in vain will await. Uptrail is *Festung* Fox Gap . . . and your cell."

The prisoner's shoulders slumped. Knecht looked at the sun. With the prisoner afoot, they should still reach the fort before nightfall. He decided to take the man in for questioning. That would be safer than interrogating him on the spot. Knecht glanced at the map once more. Then he frowned and looked more closely. "United States Geological Survey?" he asked the prisoner. "What are the United States?"

He did not understand why the prisoner wept.

There was a storm brewing in the northwest and the wind whipped through Fox Gap, tearing at the uniform blouses of the sentries, making them grab for their caps. In the dark, amid the rain and lightning, at least one man's grab was too late and his fellows laughed coarsely as he trotted red-faced to retrieve it. It was a small diversion in an otherwise cheerless duty.

What annoyed Festungskommandant Vonderberge was not that Scout Knecht chose to watch the chase also, but that he chose to do so while halfway through the act of entering Vonderberge's office. The wind blew a blizzard of paper around the room and Vonderberge's curses brought Knecht fully into the office, closing the door behind him.

Knecht surveyed the destruction. Vonderberge shook his head. He looked at Knecht. "These bits of paper," he said. "These orders and memoranda and requisitions, they are the nerve messages of the Army. A thousand messages a day cross my desk, Rudi; and not a one of them but deals with matters of the greatest military import." He clucked sadly. "Our enemies need not defeat us in the field. They need only sabotage our filing system and we are lost." He rose from his desk and knelt, gathering up papers. "Come, Rudi, quickly. Let us set things aright, else the Commonwealth is lost!"

Knecht snorted. Vonderberge was mocking him with this elaborate ridicule. In his short time at Fox Gap, Knecht had encountered the Kommandant's strange humor several times.

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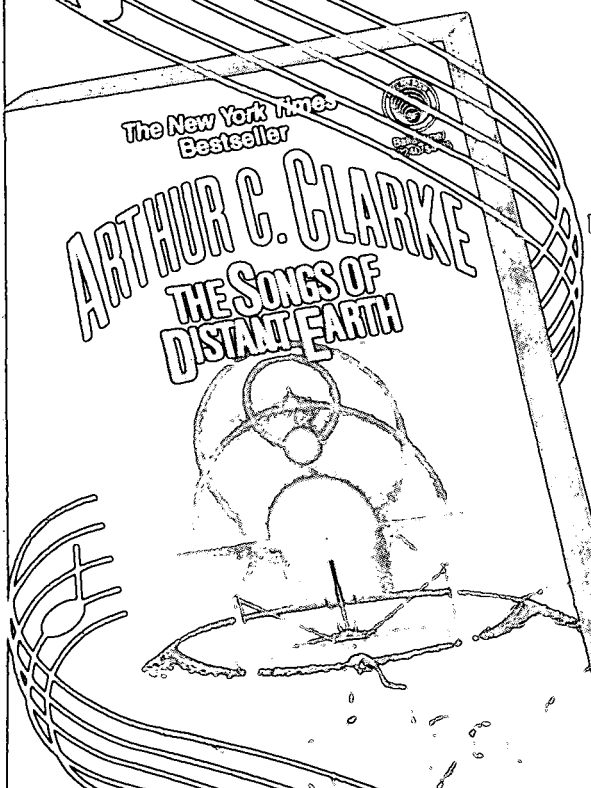

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Someone had once told him that Vonderberge had always dreamed of becoming a scientist, but that his father had pressured him into following the family's military tradition. As a result, his command style was, well, unorthodox.

Na, *we all arrive by different paths*, Knecht thought. *I joined to* spite *my father*. It startled him to recall that his father had been dead for many years and that they had never become reconciled.

Knecht stooped and helped collect the scattered documents. Because he was a scout, however, he glanced at their contents as he did so; and as he absorbed their meaning, he read more and collected less.

One sheet in particular held his attention. When he looked up from it, he saw Vonderberge waiting patiently behind his desk. He was leaning back in a swivel chair, his arms crossed over his chest. There was a knowing smile on the Kommandant's thin aristocratic face.

"Is this all . . ." Knecht began.

"*Ach, nein*," the Kommandant answered. "There is much, much more. However," he added pointedly, "it is no longer in order."

"But, this is from the prisoner, Nando Kelly?"

"Hernando is the name; not Herr Nando. It is Spanish, I believe." Vonderberge clucked sadly over the documents and began setting them in order.

Knecht stood over the desk. "But this is crazy stuff!" He waved the sheet in his hand. Vonderberge grabbed for it vainly. Knecht did not notice. "The man must be crazy!" he said.

Vonderberge paused and cocked and eyebrow at him. "Crazy?" he repeated. "So says the Hexmajor. He can support his opinion with many fine words and a degree from Franklin University. I am but a simple soldier, a servant of the Commonwealth, and cannot state my own diagnosis in so impressive a manner. On what basis, Rudi, do *you* say he is crazy?"

Knecht sputtered. "If it is not crazy to believe in countries that do not exist, I do not know what is. I have looked on all our world maps and have found no United States, not even in deepest Asia."

Vonderberge smiled broadly. He leaned back again, clasping his hands behind his neck. "Oh, I know where the United States are," he announced smugly.

Knecht made a face. "Tell me then, O Servant of the Commonwealth. Where are they?"

Vonderberge chuckled. "If you can possibly remember so far back as your childhood history lessons, you may recall something of the Fourth Pennamite War."

Knecht groaned. The Pennamite Wars. He could never remember which was which. Both Connecticut and Pennsylvania had claimed the Wyoming Valley and had fought over it several times, a consequence of the English king's cavalier attitude toward land titles. The fourth one? Let's see . . . 1769, 1771, 1775 . . .

"No," he said finally. "I know nothing at all of the time between 1784 and 1792. I never heard of Brigadier Wadsworth and the Siege of Forty-Fort, or how General Washington and his Virginia militia were mowed down in the crossfire."

"Then you must also be ignorant,"

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continued the Kommandant, "of the fact that the same Congress that sent the General to stop the fighting was also working on a plan to unify the thirteen independent states. Now what do you suppose the name of that union was to be?"

Knecht snorted. "I would be a great fool if I did not say 'The United States.' "

Vonderberge clapped. "Right, indeed, Rudi. Right, indeed. Dickinson was president of the Congress, you know."

Knecht was surprised. "Dickinson? John Dickinson, our first Chancellor?"

"The very same. Being a Pennsylvanian, I suppose the yankee settlers thought he was plotting something by dispatching the supposedly neutral Virginians. . . . Well, of course, with Washington dead, and old Franklin incapacitated by a stroke at the news, the whole thing fell apart. Maryland never did sign the Articles of Confederation; and as the fighting among the states grew worse—over the Wyoming, over Vermont, over Chesapeake fishing rights, over the western lands—the others seceded also. All that Adams and the radicals salvaged was their New England Confederation; and even that was almost lost during Shay's Rebellion and General Lincoln's coup. . . ."

Knecht interrupted. "So this almost-was United States was nothing more than a wartime alliance to throw the English out. It was stillborn in the 1780s. Yet Kelly's map is dated this year."

"*Ja,* the map," mused Vonderberge, as if to himself. "It is finely drawn, is it not? And the physical details—the mountains and streams—are astonishingly accurate. Only the man-made details are bizarre. Roads and dams that are not there. A great open space called an 'airport.' Towns that are three times their actual size. Did you see how large Easton is shown to be?"

Knecht shrugged. "A hoax."

"Such an elaborate hoax? To what purpose?"

"To fool us. He is a spy. If messages can be coded, why not maps?"

"Ah. You say he is a spy. The Hexmajor says he is mad and the map is the complex working out of a system of delusions. I say . . ." He picked up a sheaf of papers from his desk and handed them to Knecht. "I say you should read Kelly's notebook."

The scout glanced at the typewritten pages. "These are transcripts," he pointed out. "They were done on the machine in your office. I recognize the broken stem on the r's." He made it a statement.

Vonderberge threw his head back and laughed, slapping the arm of the chair. "Subtlety does not become you, Rudi," he said looking at him. "Yes, they are transcripts. General Schneider has the originals. When I showed the journal to him, he wanted to read it himself. I made copies of the more interesting entries."

Knecht kept his face neutral. "You, and the General, and the Hexmajor. *Ach!* Kelly is *my* prisoner. I have yet to interview him. I gave you his possessions for safekeeping, not for distribution."

"Oh, don't be so official, Rudi. What are we, Prussians? You were resting, I was bored, and the journal was here.

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Go ahead. Read it now." Vonderberge waved an inviting hand.

Knecht frowned and picked up the stack. The first few pages were filled with equations. Strange formulae full of inverted A's and backward E's. Knecht formed the words under his breath. ". . . twelve dimensional open manifold . . . Janatpour hypospace . . . oscillatory time . . ." He shook his head. "Nonsense," he muttered.

He turned the page and came to a text:

"I am embarking on a great adventure. Does that sound grandiose? Very well, let it. Grandiose ideas deserve grandiose expression. Tomorrow, I make my first long range Jump. Sharon claims that it is too soon for such a field test, but she is too cautious. I've engineered the equipment. I know what it can do. Triple redundancy on critical circuits. Molecular foam memory. I *am* a certified reliability engineer, after all. The short Jumps were all successful. So what could go wrong?

"Rosa could answer that. Sweet Rosa. She is not an engineer. She only sees that it is dangerous. And what can I say? It is dangerous. But when has anything perfectly safe been worth doing? The equipment is as safe as I can make it. I tried to explain about probabilities and hazard analysis to Rosa last night, but she only cried and held me tighter.

"She promised to be in the lab a week from tomorrow when I make my return Jump. A week away from Rosa. A week to study a whole new universe. *Madre de Dios!* A week can be both a moment and an eternity."

Knecht chewed his moustache. The next page was titled "Jump #1" followed by a string of twelve "coordinate settings." Then there were many pages which Knecht skimmed, detailing a world that never was. In it, the prehistoric Indians had not exterminated the Ice Age big game. Instead, they had tamed the horse, the elephant, and the camel and used the animal power to keep pace technologically with the Old World. Great civilizations arose in the river valleys of the Colorado and Rio Grande, and mighty empires spread across the Caribbean. Vikings were in Vinland at the same time the Iroquois were discovering Ireland. By the present day there were colonies on Mars.

Knecht shook his head. "Not only do we have a United States," he muttered.

The next entry was briefer and contained the first hint of trouble. It was headed "Jump #2." Except for the reversal of plus and minus signs, the coordinate settings were identical with the first set.

"A slight miscalculation. I should be back in the lab with Rosa, but I'm in somebody's apartment, instead. It's still Philly out the window—though a shabbier, more run-down Philly than I remember. I must be close to my home timeline because I can recognize most of the University buildings. There's a flag that looks like the stars and stripes on the flagpole in front of College Hall. There's something or other black hanging from the lamppost, but I can't make it out.

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Well, work first; tourism later. I bet I'll need a vernier control. There must be a slight asymmetry in the coordinates.

Knecht skipped several lines of equations and picked up the narrative once more.

"I must leave immediately! That black thing on the lamppost kept nagging at the back of my mind. So I got out my binoculars and studied it. It was a nun in a black habit, hanging in a noose. Hanging a long time, too, by the looks of it. Farther along the avenue, I could see bodies on all the lampposts. Then the wind caught the flag by College Hall and I understood. In place of the stars there was a swastika . . .

"Jump #3. Coordinates . . .

"Wrong again. I was too hasty in leaving the Nazi world. The settings were not quite right, but I think I know what went wrong now. The very act of my Jumping has created new branches in time and changed the oscillatory time-distance between them. On the shorter Jumps it didn't matter much, but on the longer ones . . .

"I think I finally have the calculations right. This is a pleasant world where I am, and—thanks to Goodman deVeres and his wife—I've had the time to think the problem through. It seems the Angevin kings still rule in this world and my host has described what seems like scientific magic. Superstition? Mass delusion? I'd like to stay and study this world, but I'm already a week overdue. Darling Rosa must be frantic with worry. I think of her often."

The next page was headed "Jump 4" with settings but no narrative entry. This was followed by . . .

"Jump #5. Coordinates unknown.

"Damn! It didn't work out right and I was almost killed. This isn't an experiment any more. Armored samurai in a medieval Philadelphia? Am I getting closer to or farther from Home? I barely escaped them. I rode north on a stolen horse and Jumped as soon as my charge built up. Just in time, too—my heart is still pounding. No time for calculations. I don't even know what the settings were.

"Note: the horse Jumped with me. The field must be wider than I thought. A clue to my dilemma? I need peace and quiet to think this out. I could find it with Goodman deVeres. I have the coordinates for his world. But his world isn't where I left it. When I jumped, I moved it. Archimedes had nothing on me. Haha. That's a joke. Why am I bothering with this stupid journal?

"I dreamed of Rosa last night. She was looking for me. I was right beside her but she couldn't see me. When I awoke, it was still dark. Off to the north there was a glow behind the crest of the hills. City lights? If that is South Mountain, it would be Allentown or Bethlehem on the other side—or their

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analogs in this world. I should know by next night. So far I haven't seen anyone; but I must be cautious.

"I've plenty of solitude here-and-now. That slag heap I saw from the mountain must have been Bethlehem, wiped out by a single bomb. The epicenter looked to be about where the steelworks once stood. It happened a long time ago, by the looks of things. Nothing living in the valley but a few scrub plants, insects and birds.

"I rode out as fast as I could to put that awful sight behind me. I didn't dare eat anything. My horse did and is dead for it. Who knows what sort of adaptations have fit the grass for a radio-active environment? I may already have stayed too long. I must Jump, but I daren't materialize inside a big city. I'll hike up into the northern hills before I Jump again."

Knecht turned to the last page. Jump #6. Settings, but no notes. There was a long silence while Knecht digested what he had read. Vonderberge was watching him. Outside, the wind rattled the windows. A nearby lightning strike caused the lights to flicker.

"Herr Festungskommandant . . ."

"His last Jump landed him right in your lap out on the Wyoming Trail."

"Herr Festungskommandant . . ."

"And instead of the solitude he sought, he's gotten solitude of another sort."

"You don't believe . . ."

"Believe?" Vonderberge slammed his palm down on the desk with unexpected violence. He stood abruptly and walked three quick paces to the window, where he gazed out at the storm. His fingers locked tightly behind his back. "Why not believe?" he whispered, his back to the room. "Somewhere there is a world where Heinrich Vonderberge is not trapped in a border fort on the edge of a war with the lives of others heavy on his back. He is in a laboratory, experimenting with electrical science, and he is happy."

He turned and faced Knecht, self-possessed once more.

"What if," he said. "What if the Pennamite Wars had not turned so vicious? If compromise had been possible? Had they lived, might not Washington and Franklin have forged a strong union, with the General as king and the Doctor as prime minister? Might not such a union have spread west, crushing Sequoyah and Tecumseh and their new Indian states before the British had gotten them properly started? Can you imagine a single government ruling the entire continent?"

Knecht said, "No," but Vonderberge continued without hearing him.

"Suppose," he said, pacing the room, "every time an event happens, several worlds are created. One for each outcome." He paused and smiled at Knecht. "Suppose Pennsylvania had not intervened in the Partition of New Jersey? No Piney War. New York and Virginia cut us off from the sea. Konrad Schneider does not become a great General, nor Rudi Knecht a famous spy. Somewhere there is such a world. Somewhere . . . close.

"Now suppose further that on one of

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these . . .these *moeglichwelten* a man discovers how to cross from one to another. He tests his equipment, makes many notes, then tries to return. But he fails."

A crash of thunder punctuated the Kommandant's words. Knecht jumped.

"He fails," Vonderberge continued, "because in the act of jumping he has somehow changed the 'distance.' So, on his return, he undershoots. At first, he is not worried. He makes a minor adjustment and tries again. And misses again. And again, and again, and again."

Vonderberge perched on the corner of his desk, his face serious. "Even if there is only one event each year, and each event had but two outcomes, why then in ten years do you know how many worlds there would have to be?"

Knecht shook his head dumbly.

"A thousand, Rudi, and more. And in another ten years, a thousand for each of those. Time is like a tree; a forest of trees. Always branching. One event a year? Two possible outcomes? *Ach!* I am a piker! In all of time, how many, many worlds there must be. How to find a single twig in such a forest?"

Knecht could think of nothing to say. In the quiet of the office, the storm without seemed louder and more menacing.

In the morning, of course, with the dark storm only muddy puddles, Knecht could dismiss the Kommandant's remarks as a bad joke. "What if?" was a game for children; a way of regretting the past. Knecht's alert eye had not missed the row of technofiction books in Vonderberge's office. "What if?" was a common theme in that genre, Knecht understood.

When he came to Kelly's cell to interrogate the prisoner, he found that others had preceded him. The guard at the cell door came to attention, but favored Knecht with a conspiratorial wink. From within the cell came the sound of angry voices. Knecht listened closely, his ear to the thick, iron door; but he could make out none of the words. He straightened and looked a question at the guard. The latter rolled his eyes heavenward with a look of resigned suffering. Knecht grinned.

"So, Johann," he said. "How long has this been going on?"

"Since sun-up," was the reply. "The Kommandant came in early to talk to the prisoner. He'd been in there an hour when the Hexmajor arrived. Then there was thunder-weather, believe me, sir." Johann smiled at the thought of two officers bickering.

Knecht pulled two cigars from his pocket humidor and offered one to the guard. "Do you suppose it is safe to leave them both locked in together?" He laughed. "We may as well relax while we wait. That is, if you are permitted . . ."

The guard took the cigar. "The Kommandant is more concerned that we are experts in how to shoot our rifles than in how to sneak a smoke." There was a pause while Knecht lit his cigar. He puffed a moment, then remarked, "This is good leaf. Kingdom of Carolina?"

Knecht nodded. He blew out a great cloud of acrid smoke. "You know you should not have allowed either of them in to see the prisoner before me."

'Well, sir. You know that and I know

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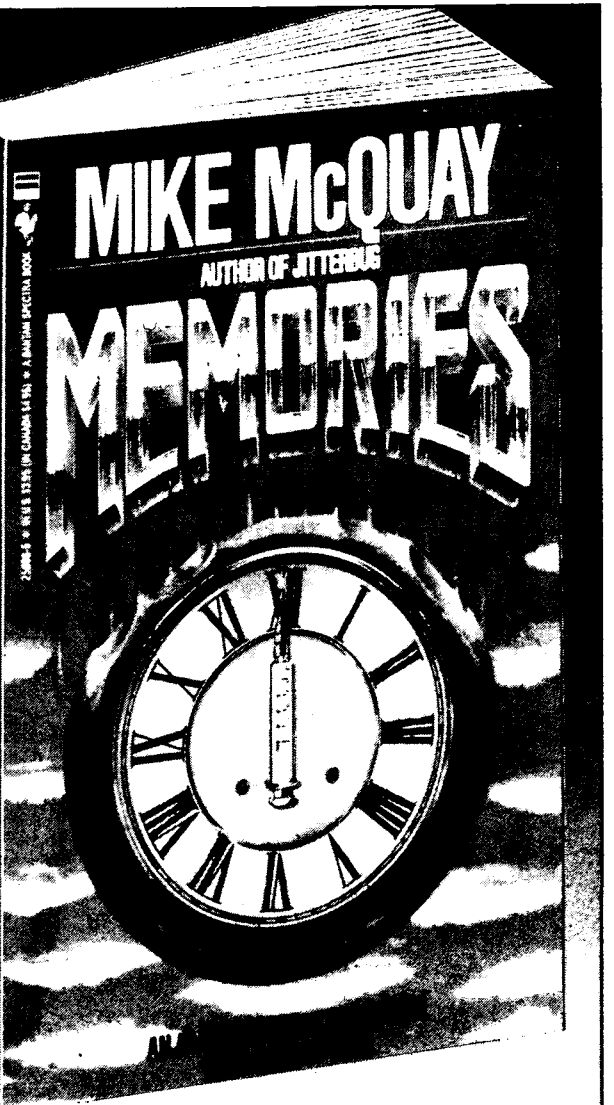

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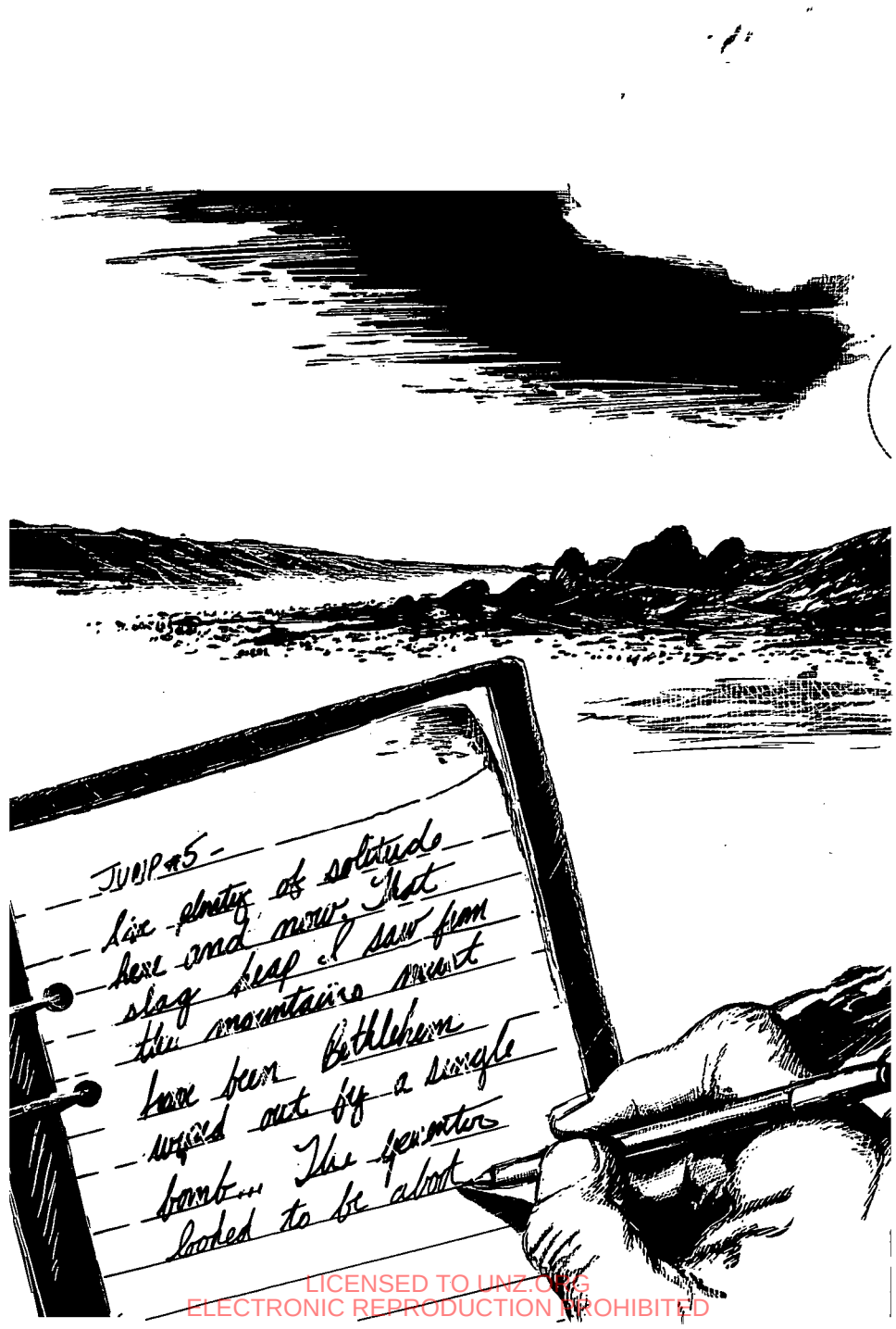

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that; but the Hexmajor and the Kommandant, they make their own rules." The argument in the cell reached a crescendo. Johann flinched. "Unfortunately, they do not make the *same* rules."

"Hmph. Is your Kommandant always so . . . impetuous?" He wanted to know Heinrich Vonderberge better; and one way to do that was to question the men who followed him.

The guard frowned. "Sir, things may be different in the Scout Corps, but the Kommandant is no fool, in spite of his ways. He always has a reason for what he does. Why, no more than two months ago—this was before you were assigned here—he had us counting the number of pigeons flying north. He plotted it on a daily chart." Johann laughed at the memory. "Then he sent us out to intercept a raiding party from the Nations. You see, you know how the sachems still allow private war parties? Well . . ."

There was a banging at the cell door and Johann broke off whatever yarn he had been about to spin and opened it. Vonderberge stalked out.

"We will see about that!" he snapped over his shoulder, and pushed past Knecht without seeing him. Knecht took his cigar from his mouth and looked from the Kommandant to the doorway. Hexmajor Ochsenfuss stood there, glaring at the Kommandant's retreating form. "Fool," the Doctor muttered through clenched teeth. Then he noticed Knecht.

"And what do *you* want? My patient is highly agitated. He cannot undergo another grilling."

Knecht smiled pleasantly. "Why, Herr Doctor. He is not your patient until I say so. Until then, he is my prisoner. I found him north of the Mountain. It is my function to interview him."

"He is a sick man, not one of your spies."

"The men I interview are never *my* spies. I will decide if he is . . . sick."

"That is a medical decision, not a military one. Have you read his journal? It is the product of a deluded mind."

"If it is what it appears to be. It could also be the product of a clever mind. Madness as a cover for espionage? Kelly would not be the first spy with an outrageous cover."

He walked past the doctor into the cell. Ochsenfuss followed him. Kelly looked up from his cot. He sat on the edge, hands clasped tightly, leaning on his knees. A night's sleep had not refreshed him. He pointed at Knecht.

"I remember you," he said. "You're the guy that caught me."

The Hexmajor forestalled Knecht's reply. "*Bitte*, Herr Leutnant," he said in Pennsylvaanish. "You must speak in our own tongue."

"*Warum?*" Knecht answered, with a glance at Kelly. "The prisoner speaks English, *nicht wahr?*"

"Ah, but he must understand German, at least a little. Either our own dialect or the European. Look at him. He is not from the West, despite his Spanish forename. Their skin color is much darker. Nor is he from Columbia, Cumberland, or the Carolina Kingdom. Their accents are most distinctive. And no white man from Virginia on north could be ignorant of the national tongue of Pennsylvania."

"Nor could any European," finished Knecht. "Not since 1917, at any rate.

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I cannot fault your logic, Herr Doctor; but then, why . . .''

''Because for some reason he has suppressed his knowledge of German. He has retreated from reality, built himself fantasy worlds. If we communicate only in Pennsylvaanish as we are doing now, his own desire to communicate will eventually overcome his 'block' (as we call it); and the process of drawing him back to the real world will have begun.''

Knecht glanced again at the prisoner. ''On the other hand, it is my duty to obtain information. If the prisoner will speak in English, then so will I.''

''But . . .''

''And I must be alone.'' Knecht tapped his lapel insignia meaningfully. The double-X of the Scout Corps.

Ochsenfuss pursed his lips. Knecht thought he would argue further, but instead, he shrugged. ''Have it your way, then; but remember to treat him carefully. If I am right, he could easily fall into complete withdrawal.'' He nodded curtly to Knecht and left.

Knecht stared at the closed door. He disliked people who ''communicated.'' Nor did he think Vonderberge was a fool like Ochsenfuss had said. Still, he reminded himself, the Hexmajor had an impressive list of cures to his credit. Especially of battle fatigue and torture cases. Ochsenfuss was no fool, either.

He stuck his cigar back between his teeth. Let's get this over with, he thought. But he knew it would not be that easy.

Within an hour Knecht knew why the others had quarreled. Kelly could describe his fantasy world and the branching timelines very convincingly. But he had convinced Vonderberge that he was telling the truth and Ochsenfuss that he was mad. The conclusions were incompatible; the mixture, explosive.

Kelly spoke freely in response to Knecht's questions. He held nothing back. At least, the scout reminded himself, he *appeared* to hold nothing back. But who knew better than Knecht how deceptive such appearances could be?

Knecht tried all the tricks of the interrogator's trade. He came at the same question time after time, from different directions. He hopscotched from question to question. He piled detail on detail. No lie could be perfectly consistent. Contradictions would soon reveal themselves. He was friendly. He was harsh. He put his own words in the prisoner's mouth to see their effect.

None of it worked.

If Kelly's answers were contradictory, Knecht could not say. When the entire story is fantasy, who can find the errors? It was of a piece with the nature of Kelly's cover. If two facts contradict each other, which is true? Answer: both, but in two different worlds.

Frustrated, Knecht decided to let the prisoner simply talk. Silence, too, was an effective tactic. Many a prisoner had said too much simply to fill an awkward silence. He removed fresh cigars from his pocket humidor and offered one to the prisoner, who accepted it gratefully. Knecht clipped the ends and lit them. When they were both burning evenly, he leaned back in the chair. Nothing like a friendly smoke to set the mind at ease. And off-guard.

''So, tell me in your own words,

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then, how you on the Wyoming Trail were found."

Kelly grunted. "I wouldn't expect the military mind to understand, or even be interested."

Knecht flushed, but he kept his temper under control. "But I am interested, Herr Kelly. You have a strange story to tell. You come from another world. It is not a story I have often encountered."

Kelly looked at him, startled, and unexpectedly laughed. "No, not very often, I would imagine."

"*Ach,* that is the very problem. Just what *would* you imagine? Your story is true, or it is false; and if it is false, it is either deliberately so or not. I must know which, so I can take the proper action."

Kelly ran a hand through his hair. "Look. All I want is to get out of here, away from you . . . military men. Back to Rosa."

"That does not tell me anything. Spy, traveler, or madman, you would say the same."

The prisoner scowled. Knecht waited.

"All right," said Kelly at last. "I got lost. It's that simple. Sharon tried to tell me that a field trip was premature, but I was so much smarter then. Who would think that the distance from B to A was different than the distance from A to B?"

Who indeed? Knecht thought, but he kept the thought to himself. Another contradiction. Except, grant the premise and it wasn't a contradiction at all.

"Sure," the prisoner's voice was bitter. "Action requires a force; and action causes reaction. It's not nice to forget Uncle Isaac." He looked Knecht square in the eye. "You see, when I Jumped, my world moved, too. Action, reaction. I created multiple versions of it. In one, my equipment worked. In others, it malfunctioned in various ways. Each was slightly displaced from the original location." He laughed again. "How many people can say they've misplaced an entire world?"

"I don't understand," said Knecht. "Why not two versions of *all* worlds? When you, ah, Jumped, you could for many different destinations have gone; and in each one, you either arrived, or you did not."

His prisoner looked puzzled. "But that's not topologically relevant. The Jump occurs in the metacontinuum of the polyverse, so . . . Ah, hell! Why should I try to convince you?"

Knecht sat back and puffed his cigar. Offhand, he could think of several reasons why Kelly should try to convince him.

"You see," the prisoner continued, "there is not an infinity of possible worlds."

Knecht had never thought there was more than one, so he said nothing. Even the idea that there were two would be staggering.

"And they are not all different in the same way. Each moment grows out of the past. Oh, say . . ." He looked at his cigar and smiled. He held it out at arm's length. "Take this cigar, for instance. If I drop it, it'll fall to the floor. That is deterministic. So are the rate, the falling time, and the energy of impact. But, I may or may not choose to drop it. That is probabilistic. It is the choice that creates worlds. We are now at a cusp, a bifurcation point on the

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Thom manifold." He paused and looked at the cigar. Knecht waited patiently. Then Kelly clamped it firmly between his teeth. "It is far too good a smoke to waste. I chose not to drop it; but there was a small probability that I would have."

Knecht pulled on his moustache, thinking of Vonderberge's speculations of the previous night. Before he had spoken with Kelly. "So you say that . . . somewhere . . . there is a world in which you did?"

"Right. It's a small world, because the probability was small. Temporal cross-section is proportional to *a priori* probability. But it's there, close by. It's a convergent world."

"Convergent."

"Yes. Except for our two memories and some ash on the floor, it is indistinguishable from this world. The differences damp out. Convergent worlds form a 'rope' of intertwined timelines. We can Jump back and forth among them easily, inadvertently. The energy needed is low. We could change places with our alternate selves and never notice. The only difference may be the number of grains of sand on Mars. Tomorrow you may find that I remember dropping the cigar; or I might find that you do. We may even argue the point."

"Unconvincingly," said Knecht sardonically.

Kelly chuckled. "True. How could you *know* what I remember? Still, it happens all the time. The courts are full of people who sincerely remember different versions of reality."

"Or perhaps it is the mind that plays tricks, not the reality."

Kelly flushed and looked away. "That happens, too."

After a moment, Knecht asked, "What has this to do with your becoming lost?"

"What? Oh. Simple, really. The number of possible worlds is large, but it's not infinite. That's important to remember," he continued to himself. "Finite. I haven't checked into Hotel Infinity. I can still find my own room, or at least the right floor." He stood abruptly and paced the room. Knecht followed him with his eyes.

"I don't have to worry about worlds where Washington and Jefferson instituted a pharaonic monarchy with a divine god-king. Every moment grows out of the previous moment, remember? For that to happen, so much previous history would have had to be different that Washington and Jefferson would never have been born." He stopped pacing and faced Knecht.

"And I don't have to worry about convergent worlds. If I find the right 'rope,' I'll be all right. Even a parallel world would be fine, as long as it would have Rosa in it." He frowned. "But it mightn't. And if it did, she mightn't know me."

"Parallel?" asked Knecht.

Kelly walked to the window and gazed through the bars. "Sure. Change can be convergent, parallel, or divergent. Suppose, oh suppose Isabella hadn't funded Columbus, but the other Genoese, Giovanni Caboto, who was also pushing for a voyage west. Or Juan de la Cosa. Or the two brothers who captained the Niña and the Pinta. There was no shortage of bold navigators. What practical difference would it have made? A few names are changed in the

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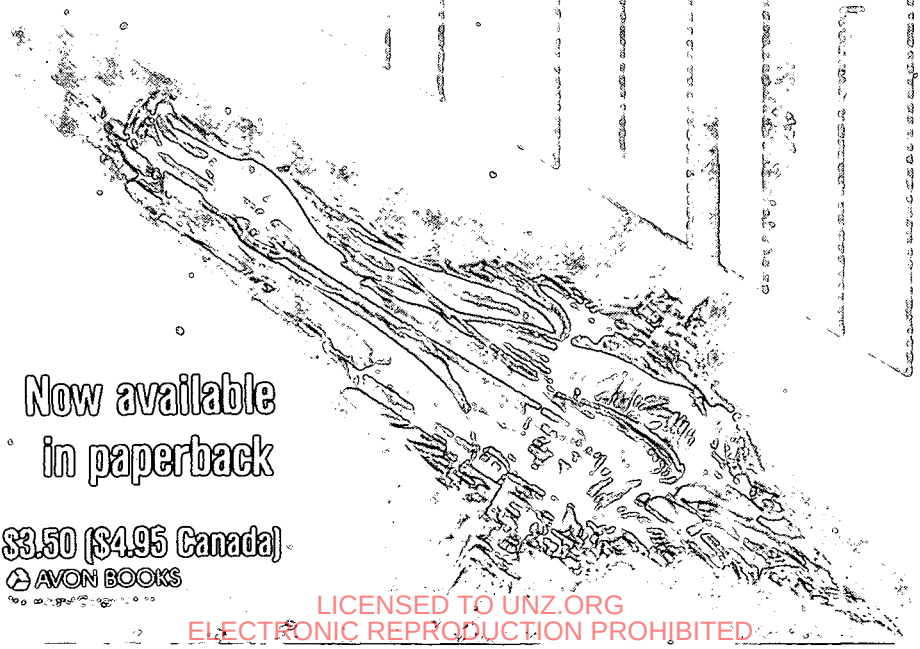

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history books, is all. The script is the same, but different actors play the parts. The differences stay constant."

He turned around. "You or I may have no counterpart in those worlds. They are different 'ropes.' Even so, we could spontaneously Jump to one nearby. Benjamin Bathurst, the man who walked behind a horse in plain sight and was never seen again. No one took his place. Judge Crater. Ambrose Bierce. Amelia Earhart. Jimmy Hoffa. The Legion II Augusta. Who knows? Some of them may have Jumped."

Kelly inspected his cigar. "Then there are the cascades. For want of a nail, the shoe was lost. The differences accumulate. The worlds diverge. That was my mistake. Jumping to a cascade world." His voice was bitter, self-mocking. "Oh, it'll be simple to find my way back. All I have to do is find the nail."

"The nail?"

"Sure. The snowflake that started the avalanche. What could be simpler?" He took three quick steps along the wall, turned, stepped back, and jammed his cigar out in the ashtray. He sat backward, landing on his cot. He put his face in his hands.

Knecht listened to his harsh breathing. He remembered what Ochsenfuss had said. If I push him too hard, he could crack. A spy cracks one way; a madman, another.

After a while, Kelly looked up again. He smiled. "It's not that hard, really," he said more calmly. "I can approximate it closely enough with history texts and logical calculus. That should be good enough to get me back to my own rope. Or at least a nearby one. As long as Rosa is there, it doesn't matter." He hesitated and glanced at Knecht. "You've confiscated my personal effects," he said, "but I would like to have her photograph. It was in my wallet. Along with my identification papers," he added pointedly.

Knecht smiled. "I have seen your papers, Herr 'Professor Doctor' Kelly. They are very good."

"But . . ."

"But I have drawn others myself just as good."

Kelly shrugged and grinned. "It was worth a try," he said.

Knecht chuckled. He was beginning to like this man. "I suppose it can do no harm," he said, thinking out loud, "to give you a history text. Surely there gives one here in the fortress. If nothing else, it can keep you amused during the long days. And perhaps it can reacquaint you with reality."

"That's what the shrink said before."

"The shrink? What . . . ? Oh, I see. The Hexmajor." He laughed. Then he remembered how Ochsenfuss and Vonderberge had quarreled over this man and he looked at him more soberly. "You understand that you must here stay. Until we know who or what you are. There are three possibilities and only one is to your benefit." He hesitated a moment, then added, "It gives some here who your story believe, and some not."

Kelly nodded. "I know. Do you believe me?"

"Me? I am a scout. I look. I listen. I try to fit pieces together so they make a picture. I take no direct action. No, Herr Kelly. I do not believe you; but neither do I disbelieve you."

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Kelly nodded. "Fair enough."

"Do not thank me yet, Herr Kelly. In our first five minutes of talking it is clear to me you know nothing of value of the Wyoming, or the Nations, or anything. In such a case, my official interest in you comes to an end."

"But unofficially . . ." prompted the other.

"*Ja.*" Knecht rose and walked to the door. "Others begin to have strong opinions about you, for whatever reasons of their own I do not know. Such are the seeds, and I do not like what may sprout. Perhaps this . . ." He jabbed his cigar at Kelly, suddenly accusing. "You know more than you show. You play-act the hinkle-dreck *Quatschkopf*. And this, the sowing of discord, may be the very reason for your coming."

He stepped back and considered the prisoner. He gestured broadly, his cigar leaving curlicues of smoke. "I see grave philosophical problems with you, Herr Kelly. We Germans, even we Pennsylvaanish Germans, are a very philosophical people. From what you say there are many worlds, some only trivially different. I do not know why we with infinitely many Kellys are not deluged, each coming from a world *almost* like your own!"

Kelly gasped in surprise. He stood abruptly and turned to the wall, his back to Knecht. "Of course," he said. "Stupid, stupid, stupid! The transformation isn't homeomorphic. The topology of the inverse sheaf must not be Hausdorff after all. It may only be a Harris proximity." He turned to Knecht. "Please, may I have my calculator, the small box with the numbered buttons . . . No, damn!" He smacked a fist into his left hand. "I ran the batteries down when I was with Goodman deVeres. Some pencils and paper, then?" He looked eager and excited.

Knecht grunted in satisfaction. Something he had said had set Kelly thinking. It remained to be seen along which lines those thoughts would run.

Rumors flew over the next few days. A small border fort is their natural breeding ground, and Fox Gap was no exception. Knecht heard through the grapevine that Vonderberge had had the Hexmajor barred from Kelly's cell; that Ochsenfuss had telegraphed his superiors in Medical Corps and had Vonderberge overruled. Now there was talk that General Schneider himself had entered the dispute, on which side no one knew; but the General had already postponed his scheduled departure for Wind Gap Fortress and a packet bearing his seal had gone by special courier to Oberkommando Pennsylvaanish in Philadelphia City. A serious matter if the General did not trust the security of the military telegraph.

The General himself was not talking, not even to Knecht. That saddened the scout more than he had realized it could. Since his talk with the prisoner, Knecht had thought more than once how slender was the chain of chance that had brought Schneider and himself together, the team of scout and strategist that had shepherded the Commonwealth through two major wars and countless border skirmishes.

He had dined with the General shortly after submitting his report on Kelly. Dinner was a hearty fare of *shnitz un' knepp*, with *deutch*-baked corn, fol-

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lowed by shoofly pie. Afterwards, cigars and brandy wine. Talk had turned, as it often did, to the Piney War. Schneider had deprecated his own role.

"What could I do, Rudi?" he asked. "A stray cannon shot and both Kutz and Rittenhouse were dead. I felt the ball go by me, felt the wind on my face. A foot the other way would have deprived this very brandy of being so thoroughly enjoyed today. Suddenly, I was Commander of the Army of the Delaware, with my forces scattered among the Wachtungs. Rittenhouse had always been the tight-lipped sort. I had no idea what his plans had been. So I studied his dispositions and our intelligence on Enemy's dispositions, and . . ." A shrug. "I improvised."

Knecht lifted his glass in salute. "Brilliantly, as always."

Schneider grinned through his bushy white muttonchop whiskers. "We mustn't forget who secured that intelligence for me. Brilliance cannot improvise on faulty data. You have never failed me."

Knecht flushed. "Once I did."

"Tcha!" The General waved his hand in dismissal. "The nine hundred ninety-nine other times make me forget the once. Only you constantly remember."

Knecht remembered how once he had misplaced an entire regiment of Virginia Foot. It was not where he had left it, but somewhere else entirely. General Schneider, except that he had been Brigadier Schneider, had salvaged the situation and had protected him from Alois Kutz's anger. He had learned something about Konrad Schneider then: The General never let the short-term interfere with the long-term. He would not sacrifice the future on the whim of the moment. It had been such a simple error. He had improperly identified the terrain. The Appalachian Mountains of western Virginia looked much the same from ridge to ridge.

Or was it so simple? He recalled his discussion with the prisoner, Kelly. *Ich biete Ihre Entschuldigung, Herr Brigadier*, he imagined himself saying, but I must have slipped over into a parallel universe. In my timeline, the Rappahannock Guards were on the north side of the river, not the south.

No, it wouldn't work. To believe it meant chaos: A world without facts. A world where lies hid among multiple truths. And what did the General think? What did Konrad Schneider make of Kelly's tale?

Knecht swirled the brandy in his snifter. He watched his reflection dance on the blood-red liquid. "Tell me, Konrad, have you read my report on the prisoner?"

"*Ja*, I have."

"And what did you think?"

"It was a fine report, Rudi. As always."

"No. I meant what did you think of the prisoner's story?"

The General lifted his glass to his lips and sipped his brandy. Knecht had seen many men try to avoid answers and recognized all the tactics. Knecht frowned and waited for an answer he knew he could not trust. For as long as Knecht could remember Schneider had been his leader. From the day he had left his father's house, he had followed Colonel, then Brigadier, then General Schneider, and never before had he been

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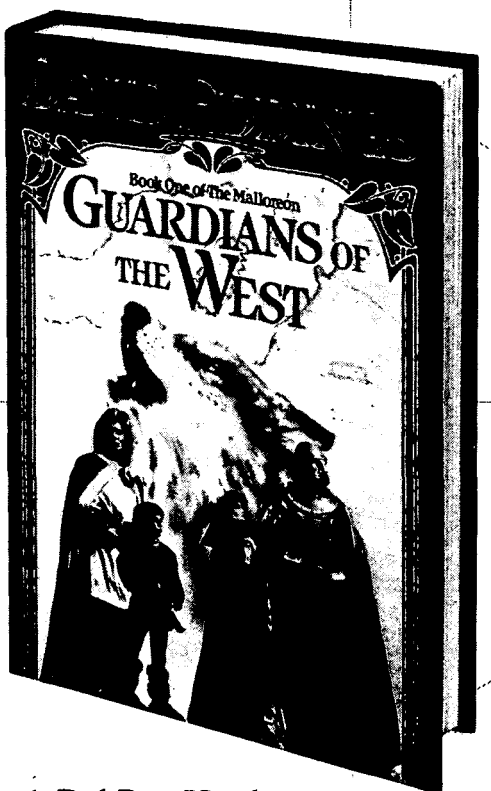

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led astray. There was an emptiness in him now. He bit the inside of his cheek so that he could feel something, even pain.

Schneider finished his slow, careful sip and set his glass down. He shrugged broadly, palms up. "How could I know? Vonderberge tells me one thing; Ochsenfuss, another. You, in your report, tell me nothing."

Knecht bristled. "There is not enough data to reach a conclusion," he protested.

Schneider shook his head. "No, no. I meant no criticism. You are correct, as always. Yet, our friends *have* reached conclusions. Different conclusions, to be sure, but we don't know which is correct." He paused. "Of course, he *might* be a spy."

"If he is, he is either a very bad one, or a very, very good one."

"And all we know is . . . What? He loves Rosa and does not love the military. He has some peculiar documents and artifacts and he believes he comes from another world, full of marvelous gadgets. . . ."

"Correction, Herr General. He *says* he believes he came from another world. There is a difference."

"Hmph. *Ja*, you are right again. What is it you always say? The map is not the territory. The testimony is not the fact. Sometimes I envy our friends their ability to reach such strong convictions on so little reflection. You and I, Rudi, we are always beset by doubts, eh?"

Knecht made a face. "If so, Konrad, your doubts have never kept you from acting."

The General stared at him a moment. Then he roared with laughter, slapping his thigh. "Oh, yes, you are right, Rudi. What should I do without you? You know me better than I know myself. There are two kinds of doubts, *nicht wahr?* One says: What is the right thing to do? The other says: Have I done the right thing? But, to command means to decide. I have never fought a battle but that a better strategy has come to mind a day or two later. But where would we be had I waited? Eh, Rudi? The second sort of doubt, Rudi. That is the sort of doubt a commander must have. Never the first sort. And never certainty. Both are disasters."

"And what of Kelly?"

The General reached for his brandy once more. "I will have both the Hexmajor and the Kommandant interview him. Naturally, each will be biased, but in different ways. Between them, we may learn the truth of it." He paused thoughtfully, pursing his lips. "Sooner or later, one will concede the matter. We need not be hasty. No, not hasty at all." He drank the last of his brandy.

"And myself?"

Schneider looked at him. He smiled. "You cannot spend so much time on only one man, one who is almost surely not an enemy agent. You have your spies, scouts, and rangers to supervise. Intelligence to collate. Tell me, Rudi, what those fat knick patroons are planning up in Albany. Have the Iroquois joined them, too? Are they dickering with the Lee brothers to make it a two-front war? I must know these things if I am to . . . improvise. Our situation is grave. Forget Kelly. He is not important."

* * *

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After he left the General, Knecht took a stroll around the parapet, exchanging greetings with the sentries. Schneider could not have announced more clearly that Kelly was important. But why? And why keep him out of it?

Fox Gap was a star-fort and Knecht's wanderings had taken him to one of the points of the star. From there, defensive fire could enfilade any attacking force. He leaned his elbows on a gun port and gazed out at the nighttime forest farther down the slope of the mountain. The sky was crisp and clear as only autumn skies could be, and the stars were brilliantly close.

The forest was a dark mass, a deeper black against the black of night. The wind soughed through the maple and elm and birch. The sound reached him, a dry whisper, like crumpling paper. Soon it would be the Fall. The leaves were dead; all the life had been sucked out of them.

He sighed. General Schneider had just as clearly ordered him away from Kelly. He had never disobeyed an order. Angrily, he threw a shard of masonry from the parapet wall. It crashed among the treetops below and a sentry turned sharply and shouted a challenge. Embarrassed, Knecht turned and left the parapet.

Once back in his own quarters, Knecht pondered the dilemma of Kelly. His room was spartan. Not much more comfortable, he thought, than Kelly's cell. A simple bed, a desk and chair, a trunk. Woodcuts on the wall: heroic details of long-forgotten battles. An anonymous room, suitable for a roving scout. Next month, maybe, a different room at a different fort.

So what was Kelly? Knecht couldn't see but three possibilities. A clever spy, a madman, or the most pitiful refugee ever. But, as a spy he was not credible; his story was unbelievable, and he simply did not talk like a madman.

And where does that leave us, Rudi? Nowhere. Was there a fourth possibility? It didn't seem so.

Knecht decided it was time for a pipe. Cigars were for talk; pipes for reflection. He stepped to the window of his room as he lit it. The pipe was very old. It had belonged to his grandfather, and a century of tobacco had burned its flavor into the bowl. His grandfather had given it to him the night before he had left home forever, when he had confided his plans to the old man, confident of his approval. He had been, Knecht remembered, about Kelly's age at the time. An age steeped in certainties.

Spy, madman, or refugee? If the first, good for me; because I caught him. If the second, good for him; because he will be cared for. He puffed. For two of the three possibilities, custody was the best answer; the only remaining question being what sort of custody. And those two choices were like the two sides of a coin: they used up all probability between them. Heads I win, Herr Kelly, and tails you lose. It is a cell for you either way. That is obvious.

So then, why am I pacing this room in the middle of the night, burning my best leaf and tasting nothing?

Because, Rudi, there is just the chance that the coin could land on its edge. If Kelly's outrageous tale were true, custody would not be the best answer. It would be no answer at all.

Ridiculous. It could not be true. He

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took the pipe from his mouth. The warmth of the bowl in his hand comforted him. Knecht had concluded tentatively that Kelly was no spy. That meant Ochsenfuss was right. Knecht could see that. It had been his own first reaction on reading the notebook. But he could also see why Vonderberge believed otherwise. The man's outlook and Kelly's amiable and sincere demeanor had combined to produce belief.

It was Schneider that bothered him. Schneider had *not* decided. Knecht was certain of that. And that meant . . . What? With madness so obvious, Schneider saw something else. Knecht had decided nothing because he was only interested in spies. Beyond that, what Kelly was or was not meant nothing.

Even if his tale is true, he thought, it is none of my concern. My task is done. I have taken in a suspicious stranger under suspicious circumstances. It is for higher authorities to puzzle it out. Why should I care what the answer is?

Because, Rudi, it was you who brought him here.

Knecht learned from Johann the guard that Vonderberge spent the mornings with Kelly, and Ochsenfuss, the afternoons. So when Knecht brought the history book to the cell a few days later, he did so at noon, when no one else was about. He had made it a habit to stop by for a few minutes each day.

He nodded to Johann as he walked down the cell block corridor. "I was never here, soldier," he said. Johann's face took on a look of obligingly amiable unawareness.

Kelly was eating lunch, a bowl of thick rivel soup. He had been provided with a table, which was now littered with scribbled pages. Knecht recognized the odd equations of Kelly's "logical calculus." He handed the prisoner the text: "The History of North America." Kelly seized it eagerly and leafed through it.

"Thanks, lieutenant," he said. "The shrink brought me one, too; but it's in German and I couldn't make sense of it."

"Pennsylvaanish," Knecht corrected him absently. He was looking at the other book. It was thick and scholarly. A good part of each page consisted of footnotes. He shuddered and put it down.

"What?"

"Pennsylvaanish," he repeated. "It is a German dialect, but it is not *Hochdeutsch*. It is Swabian with some English mixed in. The spelling makes it different sometimes. A visitor from the Second Reich would find it nearly unintelligible, but . . ." An elaborate shrug. "What can one expect from a Prussian?"

Kelly laughed. He put his soup bowl aside, finished. "How did that happen?" he asked. "I mean, you folks speaking, ah, Pennsylvaanish?"

Knecht raised an eyebrow. "Because we are Pennsylvanians,"

"So were Franklin, Dickinson, and Tom Penn."

"Ah, I see what you are asking. It is simple. Even so far back as the War Against the English the majority of Pennsylvanians were *Deutsch*, German-speakers. So high was the feeling against the English—outside of Philadelphia City, that is—that the Assembly Ger-

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man the official language made. Later, after the Revolution in Europe, many more from Germany came. They were fleeing the Prussians and Austrians."

"And from nowhere else? No Irish? No Poles, Italians, Russian Jews? 'I lift my lamp beside the golden door.' What happened to all of that?"

"I don't understand. *Ja*, some came from other countries. There were Welsh and Scots-Irish here even before the War. Others came later. A few, not many. Ranger Oswoski's grandparents were Polish. But, when they come here, then Pennsylvaanish they must learn."

"I suppose with America so balkanized, it never seemed such a land of opportunity."

"I don't understand that, either. What is 'balkanized'?"

Kelly tapped with his pencil on the table. "No," he said slowly, "I suppose you wouldn't." He aimed the pencil at the history book. "Let me read this. Maybe I'll be able to explain things better."

"I hope you find in it what you need."

Kelly grinned, all teeth. "An appropriately ambiguous wish, lieutenant. 'What I need.' That could mean anything. But, thank you. I think I will." He hesitated a moment. "And, uh, thanks for the book, too. You've been a big help. You're the only one who comes here and listens to me. I mean, *really* listens."

Knecht smiled. He opened the door, but turned before leaving. "But, Herr Kelly," he said. "It is my job to listen."

Knecht's work absorbed him for several days. Scraps of information filtered in from several quarters. He spent long hours in his office going over them, separating rumor from fact from possible fact. Sometimes, he sent a man out to see for himself and waited in nervous uncertainty until the pigeons flew back. Each night, he threw himself into his rack exhausted. Each morning, there was a new stack of messages.

He moved pins about in his wall map. Formations whose bivouac had been verified. Twice he telegraphed the Southern Command using his personal code to discover what the scouts down along the Monongahela had learned. Slowly, the spaces filled in. The pins told a story. Encirclement.

Schneider came in late one evening. He stood before the map and studied it for long minutes in silence. Knecht sipped his coffee, watching. The General drew his forefinger along the northwestern frontier. There were no pins located in Long House territory. "Curious," he said aloud, as if to himself. Knecht smiled. Five rangers were already out trying to fill in that gap. Schneider would have his answer soon enough.

Knecht had almost forgotten Kelly. There had been no more time for his noontime visits. Then, one morning he heard that Vonderberge and Ochsenfuss had fought in the officers' club. Words had been exchanged, then blows. Not many, because the Chief Engineer had stopped them. It wasn't clear who had started it, or even how it had started. It had gotten as far as it had only because the other officers present had been taken by surprise. Neither man had been known to brawl before.

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Knecht was not surprised by the fight. He knew the tension between the two over Kelly. What did surprise him was that Schneider took no official notice of the fight.

Something was happening. Knecht did not know what it was, but he was determined to find out. He decided to do a little intramural spy work of his own.

Knecht found the Hexmajor later that evening. He was sitting alone at a table in the officers' club, sipping an after-dinner liqueur from a thin glass, something Knecht found vaguely effeminate. He realized he was taking a strong personal dislike to the man. Compared to Vonderberge, Ochsenfuss was haughty and cold. Elegant, Knecht thought, watching the man drink. That was the word: elegant. Knecht himself liked plain, blunt-spoken men. But scouts, he told himself firmly, must observe what is, not what they wish to see. The bar orderly handed him a beer stein and he strolled casually to Ochsenfuss' table.

"Ah, Herr Doctor," he said smiling. "How goes it with the prisoner?"

"It goes," said Ochsenfuss, "but slowly."

Knecht sat without awaiting an invitation. He thought he saw a brief glimmer of surprise in the other's face, but the Hexmajor quickly recovered his wooden expression. Knecht was aware that Vonderberge, at a corner table, had paused in his conversation with the Chief Engineer and was watching them narrowly.

"A shame the treatment cannot go speedier," he told Ochsenfuss.

A shrug. "Under such circumstances, the mind must heal itself."

"I remember your work with Ranger Harrison after we rescued him from the Senecas."

Ochsenfuss sipped his drink. "I recall the case. His condition was grave. Torture does things to a man's mind; worse in many ways than what it does to his body."

"May I ask how you are treating Kelly?"

"You may."

There was a long silence. Then Knecht said, "How are you treating him?" He could not detect the slightest hint of a smile on the doctor's face. He was surprised. Ochsenfuss had not seemed inclined to humor of any sort.

"I am mesmerizing him," he said. "Then I allow him to talk about his fantasies. In English," he admitted grudgingly. "I ply him for details. Then, when he is in this highly suggestible state, I point out the contradictions in his thinking."

"Contradictions . . ." Knecht let the word hang in the air.

"Oh, many things. Heavier-than-air flying machines: a mathematical impossibility. Radio, communication without connecting wires: That is action at a distance, also impossible. Then there is his notion that a single government rules the continent, from Columbia to New England and from Pontiac to Texas. Why, the distances and geographical barriers make the idea laughable.

"I tell him these things while he is mesmerized. My suggestions lodge in what we call the subconscious and gradually make his fantasies less credible to

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his waking mind. Eventually he will again make contact with reality."

"Tell me something, Herr Doctor."

They both turned at the sound of the new voice. It was Vonderberge. He stood belligerently, his thumbs hooked in his belt. He swayed slightly and Knecht could smell alcohol on his breath. Knecht frowned unhappily.

Ochsenfuss blinked. "Yes, Kommandant," he said blandly. "What is it?"

"I have read that by mesmerization one can also implant false ideas."

Ochsenfuss smiled. "I have heard that at carnival sideshows, the mesmerist may cause members of the audience to believe that they are ducks or some such thing."

"I was thinking of something more subtle than that."

The Hexmajor's smile did not fade, but it seemed to freeze. "Could you be more specific."

Vonderberge leaned towards them. "I mean," he said lowly, "the obliteration of true memories and their replacement with false ones."

Ochsenfuss tensed. "No reputable hexdoctor would do such a thing."

Vonderberge raised a palm. "I never suggested such a thing, either. I only asked if it were possible."

Ochsenfuss paused before answering. "It is. But the false memories would inevitably conflict with a thousand others and, most importantly, with the evidence of the patient's own senses. The end would be psychosis. The obliteration of *false* memories, however . . ."

Vonderberge nodded several times, as if the Hexmajor had confirmed a long-standing belief. "I see. Thank you, Doctor." He turned and looked at Knecht. He touched the bill of his cap. "Rudi," he said in salutation, then turned and left.

Ochsenfuss watched him go. "There is a man who can benefit from therapy. He would reject reality if he could."

Knecht remembered Vonderberge's outburst in his office during the storm. He remembered, too, the map in his own office. "So might we all," he said. "Reality is none too pleasant these days. General Schneider believes . . .

"General Schneider," interrupted Ochsenfuss, "believes what he wants to believe. But truth is not always what we want, is it?" He looked away, his eyes focused on the far wall. "Nor always what we need." He took another sip of his liqueur and set the glass down. "I am not such a fool as he seems to think. For all that he primes me with questions to put to Kelly, and the interest he shows in my reports, he still has not decided what to do with my patient. He should be in hospital, in Philadelphia."

For the briefest moment, Knecht thought he meant Schneider should be in hospital. When he realized the confusion, he laughed. Ochsenfuss looked at him oddly and Knecht took a pull on his mug to hide his embarrassment.

"If I could use mescal or peyote to heighten his suggestibility," Ochsenfuss continued to no one in particular. "Or if I could keep our friend the Kommandant away from my patient. . . ." He studied his drink in silence, then abruptly tossed it off. He looked at his watch and waved off a hovering orderly. "Well, things cannot go on as they are. Something must break." He laughed

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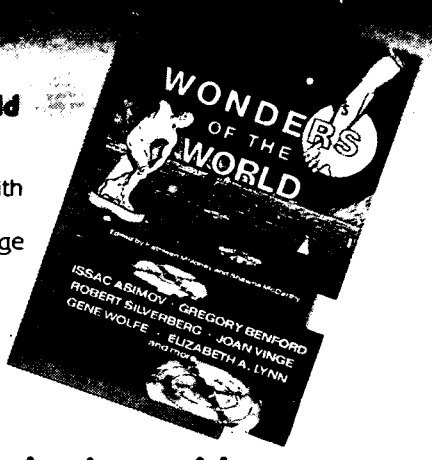

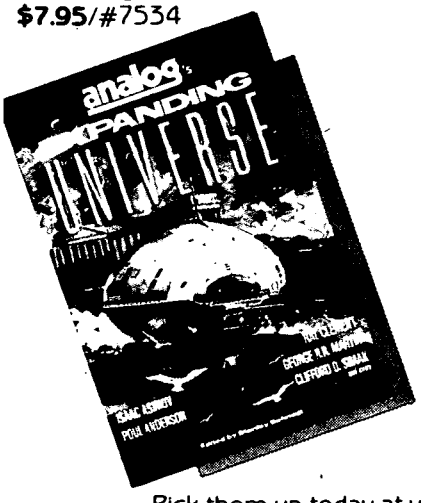

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and rose from the table. "At least there are a few of us who take a hard-headed and practical view of the world, eh, Leutnant?" He patted Knecht on the arm and left.

Knecht watched him go. He took another drink of beer and wiped the foam from his lips with his sleeve, thinking about what the Hexmajor had said.

A few days later, a carrier pigeon arrived and Knecht rode out to meet its sender at a secret rendezvous deep inside Wyoming. Such meetings were always risky, but his agent had spent many years working her way into a position of trust. It was a mask that would be dropped if she tried to leave the country. Knecht wondered what the information was. Obviously more than could be entrusted to a pigeon.

But she never came to the rendezvous. Knecht waited, then left a sign on a certain tree that he had been there and gone. He wondered what had happened. Perhaps she had not been able to get away after all. Or perhaps she had been unmasked and quietly executed. Like many of the Old-style Quakers, Abigail Fox had learned English at her mother's knee and spoke without an accent; but one never knew what trivial detail would prove fatal.

Knecht chewed on his moustache as he rode homeward. He had not seen Abby for a long time. Now he didn't know if he would ever see her again. The worst part would be never knowing what had happened. Knecht hated not knowing things. That's why he was a good scout. Even bad news was better than no news.

Well, perhaps another pigeon would arrive, explaining everything, arranging another rendezvous. *But how could you be sure, Rudi, that it really came from her?* Spies have been broken before, and codes with them. One day, he knew, he would ride out to a meeting and not come back. He felt cold and empty. He slapped his horse on the rump and she broke into a trot. He was afraid of death, but he would not send others to do what he would not.

It had been two weeks to rendezvous and back and Schneider was still at Fox Gap when Knecht returned. The rumors had grown up thick for harvesting. Between the front gate and the stables five soldiers and two officers asked him if a command shake-up were coming. His friendship with the General was well-known, and why else would Schneider stay on?

Why else, indeed. Kelly. Knecht was certain of it, but the why still eluded him.

Catching up on his paperwork kept Knecht at his desk until well after dark. When he had finished, he made his way to Vonderberge's quarters. Knecht's thought was to pay a "social call" and guide the conversation around to the subject of Kelly. Once he arrived, however, he found himself with some other officers, drinking dark beer and singing badly to the accompaniment of the Chief Engineer's equally bad piano playing. It was, he discovered, a weekly ritual among the permanent fortress staff.

Ochsenfuss was not there, but that did not surprise him.

He was reluctant to bring up the business of the prisoner in front of the other officers, so he planned to be the last to

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leave. But Vonderberge and the Fortress Staff proved to have a respectable capacity for drinking and singing and Knecht outlasted them only by cleverly passing out in the corner, where he was overlooked when Vonderberge ushered the others out.

"Good morning, Rudi."

Knecht opened his eyes. The light seared his eyes and the top of his head fell off and shattered on the floor. "Ow," he said.

"Very eloquent, Rudi." Vonderberge leaned over him, looking impossibly cheerful. "That must be some hangover."

Knecht winced. "You can't get hangovers from beer."

Vonderberge shrugged. "Have it your way." He held out a tall glass. "Here, drink this."

He sniffed the drink warily. It was dark and red and pungent. "What is it?" he asked suspiciously.

"Grandmother Vonderberge's Perfect Cure for Everything. It never fails."

"But what's in it?"

"If I told you, you wouldn't drink it. Go ahead. Grandmother was a wise old bird. She outlasted three husbands."

Knecht drank. He shuddered and sweat broke out on his forehead. "Small wonder," he gasped. "She probably fed them this."

Vonderberge chuckled and took the glass back. "You were in fine form last night. Fine form. Who is Abby?"

Knecht looked at him. "Why?"

"You kept drinking toasts to her."

He looked away, into the distance. "She was . . . someone I knew."

"Like that, eh?" Vonderberge grinned. Knecht did not bother to correct him.

"You should socialize more often, Rudi," continued the Kommandant. "You'll find we're not such bad sorts. You have a good baritone. It gave the staff a fuller sound." Vonderberge gestured broadly to show how full the sound had been. "We need the higher registers, though. I've thought of having Heinz and Zuckerman gelded. What do you think?"

Knecht considered the question. "Where do they stand on the promotion list?"

Vonderberge looked at him sharply. He grinned. "You are beginning to show a sense of humor, Rudi. A sense of humor."

Knecht snorted. He was easily twenty years the Kommandant's senior. He knew jokes that had been old and wrinkled before Vonderberge had been born. He recalled suddenly that Abigail Fox had been an alto. There were other memories, too; and some empty places where there could have been memories, but weren't. Ach, for what might have been! It wasn't right for spymaster and spy to be too close. He wondered if Kelly had a world somewhere where everything was different.

Vonderberge had his batman serve breakfast in rather than go to the mess. He invited Knecht to stay and they talked over eggs, scrapple, and coffee. Knecht did not have to lead into the subject of Kelly because Vonderberge raised it himself. He unrolled a sheet of paper onto the table after the batman had cleared it, using the salt and pepper mills to hold down the curled ends.

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"Let me show you," he said, "what bothers me about Kelly's world."

A great many things about Kelly's world bothered Knecht, not the least of which was the fact that there was no evidence it even existed; but he put on a polite face and listened attentively. Was Vonderberge beginning to have doubts?

The Kommandant pointed to the sheet. Knecht saw that it was a table of inventions, with dates and inventors. Some of the inventions had two dates and two inventors, in parallel columns.

"Next to each invention," said Vonderberge, "I've written when and by whom it was invented. The first column is our world; the second, Kelly's, as nearly as he can remember. Do you notice anything?"

Knecht glanced at the list. "Several things," he replied casually. "There are more entries in the second column, most of the dates are earlier, and a few names appear in both columns."

Vonderberge blinked and looked at him. Knecht kept his face composed.

"You're showing off, aren't you, Rudi?"

"I've spent a lifetime noticing details on documents."

"But do you see the significance? The inventions came earlier and faster in Kelly's world. Look how they *gush* forth after 1870! Why? How could they have been so much more creative? In the early part of the list, many of the same men are mentioned in both columns, so it is not individual genius. Look . . ." His forefinger searched the first column. "The electrical telegraph was invented, when? In 1875, by Edison. In Kelly's world, it was invented in the 1830s, by a man named Morse."

"The painter?"

"Apparently the same man. Why didn't he invent it here? And see what Edison did in Kelly's world: The electrical light, the moving picture projector, dozens of things we never saw until the 1930s."

Knecht pointed to an entry. "Plastics," he said. "We discovered them first." He wondered what "first" meant in this context.

"That is the exception that proves the rule. There are others. Daguerre's photographic camera, Foucault's gyroscope. They are the same in both worlds. But overall there is a pattern. Not an occasional marvel, every now and then; but a multitude, every year! By 1920, in Kelly's world, steamships, *heavier*-than-air craft, railroads, *voice* telegraphy with *and without* wires, horseless carriages, they were an old hat. Here, they are still wonders. Or wondered about."

Inventions and gadgets, decided Knecht. Those were Vonderberge's secret passion, and Kelly had described a technological faerieland. No wonder the Kommandant was entranced. Knecht was less in awe, himself. He had seen the proud ranks of the 18th New York mowed down like corn by the Pennsylvaanish machine guns at the Battle of the Raritan. And he had not forgotten what Kelly had written in his notebook: There were bombs that destroyed whole cities.

Vonderberge sighed and rolled up his list. He tied a cord around it. "It is difficult, Rudi," he said. "Very difficult. Your General, he only wants to

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hear about the inventions. He does not wonder why there are so many. Yet, I feel that this is an important question."

"Can't Kelly answer it?"

"He might. He has come close to it on several occasions; but he is . . . confused. Ochsenfuss sees to that."

Knecht noticed how Vonderberge's jaw set. The Kommandant's usual bantering tone was missing.

Vonderberge pulled a watch from his right pants pocket and studied its face. "It is time for my appointment with Kelly. Why don't you come with me. I'd like your opinion on something."

"On what?"

"On Kelly."

Knecht sat backward on a chair in the corner of the cell, leaning his arms on the back. A cigar was clamped tightly between his teeth. It had gone out, but he had not bothered to relight it. He watched the proceedings between Kelly and Vonderberge. So far, he did not like what he had seen.

Kelly spoke hesitantly. He seemed distracted and lapsed into frequent, uncomfortable silences. The papers spread out on his table were blank. No new equations. Just doodles of flowers. Roses, they looked like.

"Think, Kelly," Vonderberge pleaded. "We were talking of this only yesterday."

Kelly pursed his lips and frowned. "Were we? *Ja*, you're right. I think we did. I thought it was a dream."

"It was not a dream. It was real. You said you thought the Victorian Age was the key. What was the Victorian Age?"

Kelly looked puzzled. "Victorian Age? Are you sure?"

"Yes. You mentioned Queen Victoria . . ."

"She was never Queen, though."

Vonderberge clucked impatiently. "That was in this world," he said. "In your world it must have been different."

"In my world . . ." It was half a statement, half a question. Kelly closed his eyes, hard. "I have such headaches, these days. It's hard to remember things. It's all confused."

Vonderberge turned to Knecht. "You see the problem?"

Knecht removed his cigar. "The problem," he said judiciously, "is the source of his confusion."

Vonderberge turned back to Kelly. "I think we both know who that is."

Kelly was losing touch, Knecht thought. That was certain. But was he losing touch with reality, or with fantasy?

"Wait!" Kelly's eyes were still closed but his hand shot out and gripped Vonderberge's wrist. "The Victorian Age. That was the time from the War Between the States to World War I." He opened his eyes and looked at Vonderberge. "Am I right?"

Vonderberge threw his hands up. "Tchah! Why are you asking *me?*"

Knecht chewed thoughtfully on his cigar. *World* wars? And they were *numbered?*

"What has this 'Victorian Age' to do with your world's inventiveness?"

Kelly stared at a space in the air between them. He rapped rhythmically on the table with his knuckles. "Don't push it," he said. "I might lose the . . . Yes. I can hear Tom's voice explaining it." The eyes were unfocused. Knecht wondered what sort of mind heard voices

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talking to it. "What an odd apartment. We were just BS'ing. Sharon, Tom, and . . . a girl, and I. The subject came up, but in a different context."

They waited patiently for Kelly to remember.

"Critical mass!" he said suddenly. "That was it. The rate at which new ideas are generated depends in part on the accumulation of past ideas. The more there are, the more ways they can be combined and modified. Then, boom," he gestured with his hands. "An explosion." He laughed shrilly; sobered instantly. "That's what happened during the Victorian Age. That's what's happening now, but slower."

A slow explosion? The idea amused Knecht. "Why slower?" he asked.

"Because of the barriers! Ideas must circulate freely if they're to trigger new ones. The velocity of ideas is as important to culture and technology as, as the velocity of money is to the economy. The United States would have been the largest free trade zone in the world. The second largest was England. Not even the United Kingdom, just England. Can you imagine? Paying a toll or a tariff every few miles?"

"What has commerce to do with ideas?" asked Vonderberge.

"It's the traveling people who carry ideas from place to place. The merchants, sailors, soldiers. At least until an international postal system is established. And radio. And tourism."

"I see . . ."

"But look at the barriers we have to deal with! The largest nation on the Atlantic seaboard is what? The Carolina Kingdom. Some of the Indian states are larger, but they don't have many people. How far can you travel before you pay a tariff? Or run into a foreign language like English or Choctaw or French? Or into a military patrol that shoots first and asks questions later? No wonder we're so far behind!"

Knecht pulled the cigar from his mouth. "We?" he asked. Vonderberge turned and gave him an anxious glance, so he, too, had noticed the shift in Kelly's personal pronoun.

The prisoner was flustered. "You," he said. "I meant 'you.' Your rate of progress is slower. I . . ."

Knecht forestalled further comment. "No, never mind. A slip of the tongue, *ja?*" He smiled to show he had dismissed the slip. He knew it was important; though in what way he was not yet sure. He took a long puff on his cigar. "Personally, I have never thought our progress slow. The horseless carriage was invented, what? 1920-something, in Dusseldorf. In less than fifty years you could find some in all the major cities. Last year, two nearly collided on the streets of Philadelphia! Soon every well-to-do family will have one."

The prisoner laughed. It was a great belly laugh that shook him and shook him until it turned imperceptibly into a sob. He squeezed his eyes tight.

"There was a man," he said distantly. "Back in my hometown of Longmont, Colorado." He opened his eyes and looked at them. "That would be in Nuevo Aztlan, if it existed, which it doesn't and never has . . ." He paused and shook his head, once, sharply, as if to clear it. "Old Mr. Brand. I was just a kid, but I remember when the newspapers and TV came around. When Old Brand was a youngster, he watched

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his dad drive a stagecoach. Before he died, he watched his son fly a space shuttle." He looked intently at Knecht. "And you think it is wonderful that a few rich people have hand-built cars after half a century?"

He laughed again; but this time the laugh was brittle. They watched him for a moment, and the laugh went on and on. Then Vonderberge leaned forward and slapped him sharply, twice.

Knecht chewed his moustache. What the prisoner said made some sense. He could see how technological progress —and social change with it—was coupled with free trade and the free exchange of ideas. Yet, he wasn't at all sure that it was necessarily a good thing. There was a lot to be said for stability and continuity. He blew a smoke ring. He wondered if Kelly were a social radical, driven mad by his inability to instigate change, who had built himself a fantasy world in which change ran amok. That made sense, too.

He glanced at his cigar, automatically timing the ash. A good cigar should burn at least five minutes before the ash needed knocking off.

Suddenly, he felt a tingling in his spine. He looked at the cigar as if it had come alive in his hand. It had gone out—he remembered that clearly. Now, it was burning, and he could not recall relighting it. He looked at the ashtray. Yes, a spent match. I relit it, of course. It was such an automatic action that I paid it no mind. That was one explanation. It was his memory playing tricks, not his reality. But the tingling in his spine did not stop.

He looked at Kelly, then he carefully laid his cigar in the ashtray to burn itself out.

"You just wait, though," Kelly was saying to Vonderberge. "Our curve is starting up, too. It took us longer, but we'll be reaching critical mass soon. We're maybe 100 years off the pace. About where the other . . . where my world was just before the world wars."

That simple pronouncement filled Knecht with a formless dread. He watched the smoke from his smoldering cigar and saw how it rose, straight and true, until it reached a breaking point. There, it changed abruptly into a chaos of turbulent streamers, swirling at random in the motionless air. Then we could do the same, he thought. Fight worldwide wars.

Afterwards, Knecht and Vonderberge spoke briefly as they crossed the parade ground. The sun was high in the sky, but the air held the coolness of autumn. Knecht was thoughtful, his mind on his cigar, on alternate realities, on the suddenness with which stability could turn to chaos.

"You saw it, didn't you?" asked Vonderberge.

For a moment he thought the Kommandant meant his mysteriously relit cigar. "Saw what?" he replied.

"Kelly. He has difficulty remembering his own world. He becomes confused, disoriented, melancholy."

"Is he always so?"

"Today was better than most. Sometimes I cannot stop his weeping."

"I have never heard him talk so long without mentioning his Rosa."

"Ah, you noticed that, too. But three days ago he was completely lucid and

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calculated columns of figures. Settings, he said, for his machine. They take into account, ah . . . 'many-valued inverse functions.' " Vonderberge smiled. "Whatever that means. And, if he ever sees his machine again."

'His machine," said Knecht. "Has anyone handled it?"

"No," said Vonderberge. "Ochsenfuss doesn't think it matters. It's just a collection of knobs and wires."

"And you?"

'Me?" Vonderberge looked at him. "I'm afraid to."

"Yet, its study could be most rewarding."

"A true scout. But if we try, four things could happen and none of them good."

Knecht tugged on his moustaches. "We could open it up and find that it is an obvious fake, that it couldn't possibly work."

"Could we? How would it be obvious? We would still wonder whether the science were so advanced that we simply did not understand how it did work. Like a savage with a steam engine." The Kommandant was silent for a moment.

"That's one. You said four things could happen."

"The other three assume the machine works." He held up his fingers to count off his points. "Two: In our ignorance, we damage it irreparably, marooning Kelly forever. Three: We injure ourselves by some sort of shock or explosion."

"And four?"

"Four: We transport ourselves unwittingly to another world."

"A slim possibility, that."

Vonderberge shrugged. "Perhaps. But the penalty for being wrong is . . ."

"Excessive," agreed Knecht dryly.

"I *did* examine his 'calculator,' you know."

Knecht smiled to himself. He had wondered if the Kommandant had done that, too. Knecht had learned little from it, himself.

"It was fine work: the molded plastic, the tiny buttons, the intricate circuits and parts."

"Not beyond the capabilities of any competent electrosmith."

"What! Did you see how small the batteries were? And the, what did he call them? The chips? How can you say that?"

"I didn't mean we could build a calculating engine so small. But, is it a calculating engine? Did you see it function? No. Kelly says the batteries have gone dead. Which is convenient for him. Our regimental electrosmith could easily construct a copy that does the same thing: mainly, nothing."

Vonderberge stopped and held him by the arm. "Tell me, Rudi. Do you believe Kelly or not?"

"I . . ." Well, did he? The business with the cigar was too pat. It seemed important only because of Kelly's toying with another cigar a few weeks before. Otherwise, he would never have noticed, or thought nothing even if he had. Like the prophetic dream: It seems to be more than it is because we only remember them when they come true. "I . . . have no convincing evidence."

"Evidence?" asked Vonderberge harshly. "What more evidence do you need?"

"Something solid," Knecht snapped

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back. *Something more than that I like the prisoner and the Kommandant and I dislike the Hexmajor.* "Something more than a prisoner's tale," he said. "That becomes more confused as time goes on."

"That is Ochsenfuss' bungling!"

"Or his success! Have you thought that perhaps the Hexmajor is *curing* Kelly of a long-standing delusion?"

Vonderberge turned to go. "No."

Knecht stopped him. "Heinrich," he said.

"What?"

Knecht looked past the Kommandant. He could see the sentries where they paced the walls, and the cannon in their redoubts, and the gangways to the underground tunnels that led to the big guns fortified into the mountainside. "Real or fantasy, you've learned a lot about the prisoner's technology."

"Enough to want to learn more."

"Tell me, Henrich. Do you *want* to learn to make nuclear bombs?"

Vonderberge followed Knecht's gaze. A troubled look crossed his face and he bit his lower lip. "No, I do not. But the same force can produce electricity. And the medical science that produces the miracle drugs can tailor-make horrible plagues. The jets that fly bombs can just as easily fly people or food or trade goods." He sighed. "What can I say, Rudi. It is not the tool, but the tool-user who creates the problems. Nature keeps no secrets. If something can be done, someone will find a way to do it."

Knecht made no reply. He didn't know if a reply was even possible. Certainly none that Vonderberge would understand.

* * *

When Ranger O Brien brought the news from the Nations, General Schneider was away from the fortress, inspecting the outposts on the forward slope. Knecht received O Brien's report, ordered the man to take some rest, and decided the General should see it immediately. He telegraphed Outpost Three that he was coming and rode out.

The crest of Kittatinny Mountain and all the forward slope had been clear-cut the distance of a cannon shot. Beyond that was wilderness. Ridge and valley alternated into the distant north, dense with trees, before rising once more into the Pocono range, where Wyoming had her own fortress line. Legally, the border ran somewhere through the no-man's-land between, but the main armies were entrenched in more easily defended terrain.

Knecht reined in at the crest of the Mountain and looked back. The valley of the Lehigh was checkerboarded with broad farms. Farther away, he could discern the smoke plumes of cities at the canal and rail heads. There was a speck in the air, most likely an airship sailing south.

When he turned, the contrast with the land north of the Mountain was jarring. He must have gazed upon that vista thousands of times over the years. Now, for just an instant, it looked *wrong*. It was said to be fertile land. Certainly, enough blood had manured it. And some said there was coal beneath it. He imagined the land filled with farms, mills and mines.

At that moment of *frisson* he knew, irrationally, that Kelly had been telling the truth all along. Somewhere the

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barbed wire was used only to keep the *milch* cows safe.

And the bombs and missles? What if it were a rain of death from the other side of the world that we feared, and not a party of Mohawk bucks out to prove themselves to their elders? A slow explosion, Kelly had said. The inventions would come. Nature kept no secrets. The discoveries would be made and be given to the petty rulers of petty, quarreling states. Men with dreams of conquest, or revenge.

Knecht clucked to his horse and started downslope to the picket line. Give Konrad Schneider that, he thought. His only dream is survival, not conquest. Yet he is desperate; and desperate men do desperate things, not always wise things.

"Hah! Rudi!" General Schneider waved to him when he saw him coming. He was standing on the glacis of the outpost along with the Feldwebel and his men. The General's staff was as large as the platoon stationed there, so the area seemed ludicrously crowded. The General stood in their midst, a portly, a barrel-chested man with a large curved pipe clenched firmly in his teeth. He pointed.

"Do you think the field of fire is clear enough and wide enough?"

Knecht tethered his horse and walked to where the General stood. He had never known Schneider to ask an idle question. He decided the real question was whether Vonderberge was reliable. He gave the cleared area careful scrutiny. Not so much as a blade of grass. No force large enough to take the outpost could approach unseen. "It seems adequate," he said.

"Hmph. High praise from you, Rudi." The General sucked on his pipe, staring downslope, imagining ranks of yankees and knickerbockers charging up. "It had better be. But you did not ride out here from Fox Gap only to answer an old man's foolish questions."

"No, General."

Schneider stared at him and the smile died on his face. He put his arm around Knecht's shoulder and led him off to the side. The others eyed them nervously. When scouts and generals talked the result was often trouble.

"What is it?"

"Friedrich O Brien has returned from the Nations."

"And?"

"The League has voted six to two to join the alliance against us."

They paced together in silence. Then Schneider said, "So, who held out?"

"Huron and Wyandot."

The General nodded. He released Knecht's shoulder and walked off by himself. He turned and gave a hollow laugh. "Well, at least some of our money was well spent. In the old days, it would have been enough. League votes would have had to be unanimous. Do you think they will fight? The two holdouts, I mean."

"Do you think they will split the League, General, over Pennsylvania?"

'Hmph. No. You are right again. They will go with the majority. But, perhaps, the fighting on the west will be less what? Enthusiastic?"

"At least it is too late in the year for an offensive."

"Perhaps, Rudi. But the crops are in.

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If they think they can knock us out in a lightning-war before the snows, they may try anyway. How long can they hold their alliance together? It is unnatural. Yankees and knicks and longhousers side-by-side? Pfah! It cannot last. No, they must strike while they have Virginia with them, as well. What do you think? A holding action along the Fortress Line while the Lees strike up the Susquehannah and Shenandoah?"

"Will Virginia bleed for New York's benefit?"

Schneider nodded. "A two-front war, then." He rubbed his hands together briskly. "Well, our strategy is clear. We must stir up problems behind them. In New England or Carolina or Pontiac. And perhaps we have a few surprises of our own."

Knecht looked at him sharply. Schneider was smiling. It was a small smile, but it was a real one, not forced. "What are you talking about?"

Schneider pointed to the wires running from the outpost to the Fortress. "Suppose there were no wires to be cut or tapped. Suppose there were voices in the air, undetectable, sent from anywhere a man could carry an instrument. We would not need messengers or pigeons, either. Think how quickly we could learn of enemy formations and mobilize our own forces to meet them. The right force in the right time and place is worth regiments a mile away and a day late. Or airplanes, darting among the airships with machine guns and bombs. We could carry the fighting all the way to Wilkes Barre and Painted Post."

"Kelly."

"*Ja.*" The General chuckled. "Vonderberge tells me of these gadgets, like radio. Crazy notions. But I wonder. What if it were true? Kelly's waking mind does not remember the details of the sort of, hmph, primitive inventions we could hope to copy. And from your report I suspect he would not help us willingly. Oh, he is friendly enough; but he does not like the military and would not help us prepare for war. Especially a war none of his concern. A problem. So, I seize the moment." He clenched his fist and waved it.

"You pass along the information to Ochsenfuss and ask him to find the details by prying in his unconscious mind."

Schneider looked at him. "You knew?"

"I guessed."

"You never guess. You're offended."

"No."

"You are. But I had to leave you out. You would have cut to the truth too quickly. I knew you. If you found that Kelly was mad, well, no harm done; but I was speculating that he was just what he said he was. If that were the case, I could not allow you to prove it."

"Why not?"

"Ochsenfuss, that old plodder. He will not mesmerize except for medical reasons. If you had proven Kelly was, well, Kelly, our friend the Hexmajor would have bowed out and Kelly's secrets would have remained secret. No. I needed Ochsenfuss' skill at mesmerizing. I needed Vonderberge's enthusiasm for technofiction, so he would know what questions to ask. And, for it to work, I needed Kelly's status to remain ambiguous."

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"Then the Hexmajor does not know."

"No. He is our protective plumage. I read his reports and send them to a secret team of scientists that OKP has assembled at Franklin University. Only a few people at OKP know anything. Only I, and now you, know everything."

Knecht grunted. Ochsenfuss *did* know. At least he knew something. His remarks at the officers' club had made that clear.

"Vonderberge said we lack the tools to make the tools to make the things Kelly described."

"Then Vonderberge is short-sighted. Pfah! I am no fool. I don't ask for the sophisticated developments. Those are years ahead. Decades. But the original, basic inventions, those are different. As Kelly described it, they came about in a world much like our own. And, Rudi?"

"*Ja,* Herr General?"

"This morning I received word from Franklin. They have sent telegraphic messages *without wires* between Germantown and Philadelphia. They used a special kind of crystal. The pulses travel through the air itself." He grinned like a child with a new toy.

Knecht wondered how much difference such things would make in the coming war. There wasn't time to make enough of them and learn how to use them. He also remembered what Ochsenfuss had said in the officers' club. Something had to break. The question was what. Or who.

Knecht took a deep breath. "It's over, then. You've learned how to make radio messages. Ochsenfuss can stop treating him."

Schneider would not meet his eyes. "The mesmerization must continue. There are other inventions. We need to know about airframes. The details are sketchy yet. And napalm. And . . ."

"Between Ochsenfuss and Vonderberge, Kelly's personality is being destroyed. He hardly remembers who he is, or which world is real."

"This is war. In war there are casualties. Even innocent ones."

"It is not Kelly's war."

"No. But it is yours."

Knecht's mouth set in a grim line. "*Ja,* Herr General."

"You make it look so easy," said Vonderberge.

"Shh," hissed Knecht. He twisted his probe once more and felt the bolt slide back. "These old style locks are easy, and I've had much practice." He pulled the storeroom door open and they stepped inside.

"Schneider will know you did it. Who else has your skill with locks?"

Knecht scowled. "Every scout and ranger in the Corps. But, yes, Schneider will know it was me."

Vonderberge began searching the shelves. "Does that bother you?"

Knecht shrugged. "I don't know. It should. The General has been . . . like a father to me."

"Here it is," said Vonderberge. He stepped back, Kelly's rucksack in his hands. He looked inside. "Yes, the belt controls are here also. I don't think anyone has touched it. Schneider has the only key."

"Do you suppose it still works?"

Vonderberge's hands clenched around the straps. "It must."

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They crossed the parade ground to the brig. It was dark. Knecht felt that he should dart from cover to cover; but that was silly. They were officers and they belonged here. They took salutes from three passing soldiers. Everything was normal.

The night guard in the cell block shook his head sadly when he saw them coming. "In the middle of the night, sir?" he said to Vonderberge. "Hasn't that poor bastard spilled his guts yet? Who is he, anyway?"

"As you said, soldier," Vonderberge answered. "Some poor bastard."

While the guard unlocked the cell door, Vonderberge hefted the rucksack, getting a better grip. He stroked the canvas nervously. Knecht could see beads of perspiration on his forehead.

Well, he's risking his career, too, he thought.

"We will never have a better chance, Rudi," Vonderberge whispered. "Kelly was very clear this morning when I told him what we proposed to do. He had already calculated settings several days ago, using his new 'formula.' He only needed to update them. I arranged a diversion to keep Ochsenfuss away from him, so he has not been mesmerized in the meantime. Tomorrow and he may relapse into confusion once more."

"As you say," said Knecht shortly. He was not happy about this. For Knecht, his career was his life. He had been army since his teens. A scout, and a good one; perhaps the best. Now it was on the Line. A scout observes and listens and pieces things together. He does not initiate action. How many times had he said that over the years? He had said it to Kelly. Why should he break his code now, for a man he hardly knew?

Knecht didn't know. He only knew that it would be worse to leave Kelly where he was. An obligation? Because I brought him here? Because of what we might learn from him?

Perhaps I could have argued Konrad into this, he thought. And perhaps not. And if not, there would have been a guard on that storeroom door, and restricted access to the prisoner, and so I have to do this by night and by stealth.

The guard came suddenly to attention. Knecht looked around and saw Ochsenfuss entering the corridor from the guardroom. Vonderberge, already stepping inside the cell, saw him, too. He grabbed Knecht's shoulder. "Talk to him. Keep him out until it's too late."

Knecht nodded and Vonderberge pulled the door shut. Knecht had a momentary glimpse of Kelly, rising from his cot fully dressed. Then the door closed and Ochsenfuss was at his side. The guard looked at them and pretended to be somewhere else. Knecht wondered what he would say to the Hexmajor that would keep him out.

"Up late, *Herr Doctor*," he said. *Clever, Rudi. Very clever.*

"Insomnia," was the reply. "A common malady, it seems. You might ask who is *not* up late, whiling away the hours in the guardhouse. Do you have a cigar?"

The request caught Knecht by surprise. Dumbly, he took out his pocket humidor. Ochsenfuss made a great show of selecting one of the cigars inside. Knecht took one also and offered one to the guard, who refused.

"Fire?" Ochsenfuss struck a match

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for Knect, then lit his own. After a moment or two, he blew a perfect smoke ring. "I had an interesting experience today."

"Oh?" Knecht glanced at the guard, who decided this would be a good time to patrol the outside of the building.

"*Ja*. I had a message from Outpost 10. The farthest one. One of the men was behaving oddly. Confinement mania, perhaps. But when I arrived, no one knew about the message. Or, more precisely, no one *acknowledged* knowing about the message. Odd, don't you think?"

"A hoax." Dimly, through the door, Knecht could hear a low pitched hum. The floor seemed to be vibrating, ever so slightly. He thought he could detect a faint whiff of ozone in the air. He studied the doctor's face, but saw no sign of awareness.

"Certainly a hoax. That was obvious. But to what purpose? Simply to laugh at the foolish doctor? Perhaps. But perhaps more. I could see but two possibilities, logically. The message was to make me do something or to prevent me from doing something."

Knecht nodded. "That does seem logical." The night air was cool, but he could feel the sweat running down his back, staining his shirt. The humming rose in pitch.

"Logic is a useful tool," Ochsenfuss agreed inanely. "As nearly as I could tell, the only thing the message made me do was to ride down the Mountain and back up. That did not seem to benefit anyone."

"Is there a point to this, *Herr Doctor?*" Knecht felt jumpy. Abruptly, the humming rose sharply in pitch and dropped in volume, sounding oddly like the whistle of a railroad train approaching and receding at the same time. Then it was gone. Knecht suppressed the urge to turn around. He swallowed a sigh of relief.

"What remains?" Ochsenfuss continued. "What was I prevented from doing? Why treating Kelly, of course. And who has been my opponent in the treatment? The Festungskommandant. So, since my return, I have been watching."

Knecht took the cigar from his mouth and stared. "*You* spied on *me?*"

Ochsenfuss laughed. A great bellow. He slapped Knecht's shoulder. "No, I pay you a high compliment. No one could watch you for long without you becoming aware of the fact. A sense shared by all scouts who survive. No, I followed Vonderberge. When you met him at the storeroom, I retired. It was obvious what you intended to do."

Knecht flushed. "And you told no one?"

Ochsenfuss sucked on his cigar. "No. Should I have?" He paused and pointed the stub of his cigar at the cell door. "He's not coming out, you know."

"What? Who?"

"Your friend, Vonderberge. He's not coming out. He's gone."

Knecht turned and stared at the door. "You mean he took the equipment and left Kelly behind?"

"No, no. They left together. If they stayed close, if they hugged, they would both be inside the field,"

"Guard!" bellowed Knecht. "Open this door!" The guard came pounding down the corridor. He unlocked the door and he and Knecht crowded inside. The

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cell was empty. Knecht saw that Ochsenfuss had not bothered to look. The guard gave a cry of astonishment and ran to fetch the watch-sergeant. Knecht stepped out and looked at the doctor.

The doctor shrugged. "I told you he would reject reality if he could."

"Explain that!" Knecht pointed to the empty cell.

Ochsenfuss blew another smoke ring. "He ran from reality." With a sudden motion, he kicked the cell door. It swung back and banged against the wall. "This is reality," he said harshly. "Vonderberge has fled it. How else can I say it?"

"Obviously, the other worlds are no less real. The evidence is there, now."

"What of it? It is the flight that matters, not the destination. What if the next world fails to please him? Will he reject that reality as well?"

A squad of soldiers came pelting from the guardroom. They pushed past Knecht and Ochsenfuss and crowded into the cell. Their sergeant followed at a more majestic pace.

"How long have you known," Knecht asked Ochsenfuss, "that the other worlds were real?"

Ochsenfuss shrugged. "Long enough." He laughed. "Poor, dull-witted Ochsenfuss! He cannot see a fact if it bit him on the nose." The Hexmajor's lips thinned. "Granted, I am no physical scientist, but what Kelly said went against everything I had ever read or heard. Later, I came to know I was wrong." Another shrug. "Well, we grow too soon old and too late smart. But I ask you, why did Vonderberge believe? He was correct from the beginning, but he believed before he had any real proof. He believed because he *wanted* to believe. And that, too, is madness."

"And Schneider?"

"Schneider never believed. He was making a bet. Just in case it was true. *He was playing games with my patient!*"

Knecht could see genuine anger now. The first real emotion he had ever seen in the Hexmajor. He saw the General for a moment through the Doctor's eyes. It was a side of Konrad he did not care for.

They spoke in an island of calm. Around them soldiers were searching, looking for tunnels. Schneider would be coming soon, Knecht realized. Perhaps it was time to leave, to postpone the inevitable. He and the Doctor walked to the front of the guardhouse but they went no further than the wooden portico facing the parade ground. There was really no point in postponement.

Knecht leaned on the railing, looking out over the parade ground. A squad of soldiers marched past in the dusk: full kit, double-time. Their sergeant barked a cadence at them. Idly, Knecht wondered what infraction they had committed. Across the quadrangle, the Visiting Officers' Quarters were dark.

"So why, after you knew, did you continue to treat him?" He looked over his shoulder at the Doctor.

Ochsenfuss waved his hands. The glowing tip of his cigar wove a complex pattern in the dark. "You read his journal. Do you really suppose he has found his way home this time? No, he goes deeper into the forest of time, hopelessly lost. And Vonderberge with him. Six worlds he had visited already and in

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what? In three of them, he was in danger. The next world may kill him."

"But . . ."

"Tchah! Isn't it obvious? He was driven to try. He had friends, family. His darling Rosa. Left behind forever. He could not bear the thought that he would never, ever see her again. How could he not try? How could he not fail? With me he had a chance. I saw it and I took it. If I could make him accept *this* world as the only reality, forget the other, then he might have adjusted. It was a daring thing to try."

Knecht looked back out at the parade ground. There had been a fourth possibility, after all. A refugee, but one slowly going mad. Lightning bugs flashed in the evening air. "It was daring," he agreed, "and it failed."

"Yes, it failed. His senses worked for me: everything Kelly saw and heard told him this world was real; but in the end there were too many memories. I could not tie them all off. Some would remain, buried under the false ones, disturbing him, surfacing in his dreams, eventually emerging as psychoses. I restored his memories, then. I could do no more to help him, so I made no effort to stop you."

Knecht's mind was a jumble. Every possible action was wrong. Whether Kelly had been the person he claimed to be, or a madman, Schneider had done the wrong thing. Ochsenfuss had been wrong to try and obliterate the man's true memories. As for himself, all he and Vonderberge had accomplished was to turn him out into a trackless jungle. Oh, we all had our reasons. Schneider wanted defense. Ochsenfuss wanted to heal. Vonderberge wanted escape. And I . . . Knecht wasn't sure what he had wanted.

"We could have kept him here, without your treatment," he told Ochsenfuss. "So the General could have learned more." Knecht was curious why the Doctor had not done that.

As if on cue, the door of the VOQ burst open. Knecht could see Schneider, dressed in pants and undershirt, framed in its light. Schneider strode toward the guardhouse, his face white with rage and astonishment.

Ochsenfuss smiled. "Kelly would have lost what sanity he had left. If we had not given him the way home, we have at least given him hope. And . . ." He looked in Schneider's direction. "While I am a logical man, I, too, have feelings. Your General thought to make me the fool. So, I made a medical decision in my patient's best interest."

Knecht could not help smiling also. "Perhaps I can buy you a drink tomorrow, in the officers' club. If we are both still in the army by then." His cigar had gone out. He looked at it. "I wonder what world they are in now."

"We will never know," replied Ochsenfuss. "Even if they try to come back and tell us, this world is a twig in an infinite forest. They will never find us again. It will be bad for you, Rudi, if you cannot bear not knowing."

Knecht threw his cigar away. He was a scout. It would be bad for him, not knowing. ■

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● I know of no more encouraging fact than the unquestionable ability of man to elevate his life by conscious endeavor. It is something to be able to paint a particular picture, or to carve a statue, and so to make a few objects beautiful; but it is far more glorious to carve and paint the very atmosphere and medium through which we look, which morally we can do. To affect the quality of the day, that is the highest of the arts.

Henry David Thoreau, *Walden*
Submitted by Dave Humm

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Ben Bova

MOONBASE ORIENTATION MANUAL I: TRANSPORT AND MANUFACTURING

EDITOR'S NOTE

The year is 2036. You are on your way to the Moon to begin a job at Moonbase, one of two flourishing and growing settlements on that new world, located in the northwest quadrant of the crater Alphonsus. On the way you read this book, provided by your new employer to prepare all its new employees for their new way of life.

In 1987, these pages are adapted from *Welcome to Moonbase! A Moonbase Orientation Manual,* to be published in Fall 1987 by Ballantine Books, which will deal with an even wider range of problems and opportunities of lunar life. From a 1987 point of view, the *Manual* describes how things *can* be in fifty years—if enough people start making them so now.

Meanwhile, if it should happen that something in the future described here suggests a story you'd like to try writing, Ben Bova has kindly given his permission and encouragement for you to use his background. And Stanley Schmidt would be delighted to consider such stories for *Analog*.

HUB OF THE SOLAR SYSTEM: LUNAR TRANSPORTATION NODE

Moonbase is the most important transportation node in the solar system. The current exploration of Mars, the development of resource centers among the Main Belt asteroids, and the probes of the other planets and moons of the solar system are all entirely dependent on lunar resources, facilities, and personnel. Lunar resources also feed the growing industrial, commercial, and scientific facilities in Earth orbit.

The key to Moonbase's importance in space transportation derives from two basic physical facts:

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1. Because of the Moon's low gravity and airlessness, it takes twenty-two times less energy to launch a payload from the Moon than from the Earth. With a fully operational and nearly self-sufficient Moonbase, this means that it is very nearly twenty-two times less expensive to launch payloads from the Moon than from Earth.

Spacecraft lifting from Earth carry less than five percent of their total weight as payload. The bulk of their lift-off weight is propellants to fight gravity. Spacecraft lifting from the Moon can be fifty percent payload—and unmanned cargoes launched by Moonbase's mass driver are more than ninety percent payload!

2. The Moon is rich in resources that are important to space transportation and construction. Among those resources are construction materials such as aluminum, magnesium, silicon, titanium and steel; propellants such as oxygen and aluminum; electronic materials such as silicon and gallium; and life-support supplies such as oxygen and food.

The Oxygen Trade

From the beginnings of the Space Age, by far the largest tonnage of all the materials lifted from Earth was oxygen. Liquid oxygen was used (and still is) for life support, for fuel cells that generate electricity aboard spacecraft, but mainly as a rocket propellant. Indeed, most of the mass of spacecraft leaving Low Earth Orbit (LEO) and heading for the Moon consisted of liquid hydrogen fuel and liquid oxygen. For example, a lunar landing vehicle that delivered thirty tons of payload to the Moon's surface required nearly two hundred tons of propellant!

Moreover, most of the propellant mass was oxygen. The ratio of oxygen to hydrogen was always at least six to one, by mass. Thus approximately seventy-five percent of *all* the mass lifted from Earth was oxygen. Clearly, if lunar oxygen could replace oxygen lifted from Earth, it would result in a great cost saving.

This is why one of the first "temporary" camps set up on the Moon was quickly developed into a highly-automated facility for producing liquefied oxygen out of lunar regolith materials. This earliest "Lunox*" facility was built to operate unattended for months at a time. It produced 150 tons of liquid oxygen per month. It changed forever the way the human race operates in space.

Until the Lunox facility went "on line," all space missions depended entirely on propellants and supplies from Earth. In effect, this was a tether, a leash—and a very short one, at that—that kept all space missions tied closely to Earth, and very expensive. In those primitive days, space missions were actually "sorties," brief flights into orbit or to the Moon. Permanent occupation of space by human beings was not economically possible.

To be sure, there were several space stations in LEO, and probes had been

*Lunox is a registered trade name of Moonbase Inc. and as such should always be capitalized.

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sent out to explore all the other planets of the solar system.

But the space stations were small and expensive to maintain. They could not be expanded into the huge orbiting facilities we have today as long as they were dependent on Earth for every molecule of oxygen and all the other supplies they required. And the planetary probes were remotely-controlled unmanned vehicles that provided enormous new scientific information about the other worlds of our solar system, but also raised fascinating new questions that could be answered only by human explorers. Yet planetary missions that required many months or even years in transit were beyond the capabilities of turn-of-the-century space technology, for economic reasons as much as technological ones.

The availability of lunar oxygen was the first step in breaking that short tether, the first step toward giving the human race the freedom to expand throughout the solar system.

The step was not taken cheaply. More than four hundred tons of equipment had to be landed on the Moon before the Lunox facility could go into operation. More than sixty lunar landing missions were required, over a period of three and a half years. Five lives were lost.

What developed, though, was a trade between the space stations in LEO and the growing Lunox facility on the Moon—the facility that eventually became the seed from which Moonbase grew.

Moon-bound spacecraft left the space stations carrying cargoes of hydrogen (in addition to other payloads such as equipment, supplies and personnel). They delivered the hydrogen to the Lunox facility, where it was used partly to produce water and partly for the chemical process that yielded oxygen from the powdery topmost layer of the regolith, the sandy material that the geologists call "fines." The spacecraft left the Moon and headed back to LEO loaded with lunar oxygen.

In effect, lunar oxygen became a commodity that was traded for whatever the early lunar bases required. The spacecraft that returned to the space stations in LEO carried enough Lunox to repay the costs of their trip to the Moon, *plus* a "profit" of lunar oxygen that could be delivered to the factories and other facilities that were being built in LEO at that time.

The Lunox Facility

The original Lunox facility used a process in which hydrogen was reacted with ilmenite from the lunar regolith to produce water. Some of the water was stored for life support and housekeeping at the Lunox facility. A smaller percentage was shipped to other lunar bases, for similar purposes. More than ninety percent of the water, however, was electrolyzed into its component gases, hydrogen and oxygen. The hydrogen was kept at the Lunox facility for further use in the process. The oxygen was shipped Earthward.

Thus, once the Lunox facility became operational it was able to provide a significant share of its own hydrogen input, cutting down the amount that needed to

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be imported from Earth to the small quantity required to make up losses. As the facility improved in efficiency and grew in size, less and less imported hydrogen was needed.

The powdery lunar soil was scraped from the regolith by automated front-end loaders that carried the undifferentiated fines to a shaker screen. There the larger rocks were separated, and the finer powder was carried by conveyor belt to a two-stage separator. Using standard electrostatic techniques long established in ore-processing plants on Earth, the separator removed the oxygen-bearing ilmenite from the rest of the soil material.

The unused material, which consisted of more than ninety percent of the total amount of soil processed, was moved by conveyor to a dump site. It did not remain there for long, however. Much of it was used as shielding material, spread over habitation and work modules that were partially buried in trenches, to protect their interiors against radiation and micrometeorites.

The separated ilmenite was fed into a hydrogen reduction unit where it was heated to 700°C at a pressure of 2.7 atmospheres. Under these conditions, approximately ten percent of the ilmenite mass was extracted as oxygen, combined with the hydrogen in the form of water vapor. The hydrogen combines chemically with the iron oxide in the ilmenite ($FeO.TiO_2$) in accordance with the formula:

$H_2 + FeO.TiO_2 + HEAT \blacklozenge Fe + TiO_2 + H_2O$

The powdered iron and titanium oxide produced in this process were then stockpiled for future use as construction materials.

The water vapor was then cooled by a radiator system until it became liquid. At that point the water was separated into two batches: one for use in the lunar bases, the other for electrolysis. The amount retained for lunar use varied depending on the needs of the moment, but at all times the Lunox facility managers sought to keep it below the ten percent mark.

Electrical energy was applied to the water, splitting it into gaseous hydrogen and oxygen.

$2H_2O + ENERGY \blacklozenge 2H_2 + O_2$

The hydrogen was reapplied to the input of the processing operation. The oxygen was liquefied and stored in well-insulated tanks in readiness for export.

The electrolysis and liquefaction units both generated large amounts of heat. In the vacuum of the Moon's surface, the surest way to get rid of unwanted heat was through radiation. Convection and conduction, two of the most common ways to dispose of excess heat on Earth, do not work in a vacuum. (Although it is possible, on the Moon, to conduct heat into the lunar soil. In effect, the solid body of the Moon becomes a "sink" for unwanted heat.)

Thus the electrolysis and liquefaction units were equipped with large radiator surfaces. Some of the heat generated in these processes was eventually routed through heat exchangers and used to pre-heat the incoming ore in preparation for separation and oxygen removal.

To produce a nominal 150 tons of

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oxygen per month, the Lunox facility required an electrical power capacity of 6000 kilowatts. This was provided by a nuclear power plant. By far the heaviest piece of equipment brought to the Moon at that time, the power plant massed more than 200 tons. It is still in use, mainly as a back-up facility for Moonbase's solarvoltaic energy farms.

In those bootstrap years, the Lunox facility not only supplied oxygen as an "export item" to pay for "importing" equipment and supplies; some of the oxygen and water produced at the Alphonsus base was used by the Moon-based team themselves for life support and transportation.

The oxygen-production facilities were constantly uprgraded. Among the first steps toward improving the efficiency of the system was to use heat from sunlight, focused by parabolic mirrors, to preheat the ilmenite and to dissociate the water directly, eliminating the need for electrolysis. This, combined with the growing amount of electrical energy provided by solarvoltaic cells, allowed Moonbase to convert the original nuclear power plant to its current back-up role.

Today, *all* the oxygen used off-Earth comes from the Moon, except for the oxygen generated on the moons and surface of Mars by the exploration teams based there.

And today, of course, oxygen is processed from lunar ores by a variety of means, including the original hydrogen reduction process. Most of the latest techniques for oxygen production are the proprietary techniques of Moonbase Inc., and are not for public discussion. If you are going to be employed in the oxygen production facilities of the Transportation Program Office, you will be expected to maintain secrecy concerning corporate proprietary information.

Expanding Trade

From exporting oxygen, it was a relatively easy step to export rocket fuels and construction materials, as well.

Powdered aluminum was the first rocket fuel exported from the Moon. At first the aluminum was produced by scavenging spent rocket stages. Instead of leaving the empty tankage and spacecraft shells on the lunar surface, they were processed into powdered aluminum and used to fuel lunar hoppers and lobbers. Tankage left in orbit around the Moon was recovered and similarly used.

Aluminum fuel is not as efficient for rocket propulsion as hydrogen. Rocket efficiency is rated in terms of *specific impulse*, essentially a measure of how many seconds a gram of propellants will give a gram of thrust. For various fuel/oxidizer mixtures, specific impulse (I_{sp}) is rated as follows:

Fuel	*Oxidizer*	*Specific Impulse*
Hydrogen	Oxygen	460 - 485 sec
Silane	Oxygen	370 - 400 sec
Al/HTPB	Oxygen	290 - 310 sec
Aluminum	Oxygen	270 sec

Silane is a compound of silicon and hydrogen (SiH_4); silicon is abundant on the Moon, but the hydrogen must be imported from Earth.

Al/HTPB is a mixture of aluminum

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and a solid-rocket propellant, *hydroxy-terminated polybutadine*, similar to the kind used in the strap-on solid rocket motors for the original space shuttle. The aluminum is easily available on the Moon; the HTPB must be imported.

Although the aluminum/oxygen propulsion system is not as efficient as the others, it has the great advantage of using only lunar resources. There is no need for any material to be brought up from Earth.

Lunar oxygen can also be used as the sole propellant in rocket systems where the basic energy is derived from nuclear heat or electricity, rather than from chemical combustion.

In a nuclear-powered spacecraft, the heat generated by a nuclear reaction is used to accelerate a "working fluid," or propellant. The lighter in molecular weight the propellant is, the more velocity it will gain from the same input of heat. Thus, the most efficient nuclear-powered spacecraft utilize hydrogen as their propellant. Nuclear-powered spacecraft using lunar oxygen propellant have relatively low specific impulses, up to 120 sec.

Lunar oxygen (as well as other propellants) can be used in conjunction with an electrical rocket system, such as an ion thruster or a plasma arc jet. Although very high specific impulses are obtained, in the range of 3,000 to 10,000 sec, electrical propulsion systems generally produce very low thrusts. This is because the system must carry an on-board electrical power generator, and the more thrust desired, the larger the generator must be.

Low-thrust systems cannot attain high velocities quickly. But because electrical rockets are very efficient, they can continue to operate for extremely long periods of time. Picture a bicyclist in a race against a sports car. The sports car can easily out-accelerate the cyclist and can go much faster—until the car runs out of fuel. The cyclist can eventually pedal past the stranded sports car and keep on going indefinitely, as long as the cyclist can eat while pedaling.

Low-thrust electrical rockets, therefore, are used for unmanned cargo missions between LEO and lunar orbit, and for very-long-duration missions, such as unmanned probes to the distant planets. For missions as far as the Main Asteroid Belt, some 400 million kilometers from the Sun, solar cells can provide the electricity for electrical rockets. At distances beyond that, nuclear power sources are used.

Lunar oxygen is one of the major propellants used in electrical rockets throughout the solar system. Again, propellants with lighter molecular weights, such as hydrogen, helium, lithium and nitrogren offer higher specific impulses. But lunar oxygen is abundant and inexpensive, two factors that work in its favor in almost every space mission.

A competing low-thrust, high-efficiency form of space transportation is the *solar sail*. Huge gossamer sails of ultrathin plastic, several square kilometers in area, catch the microscopic pressure of sunlight and glide through the frictionless vacuum of interplanetary space. Of the fifteen solar sail auto-

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mated probes now drifting outward toward the fringes of the solar system, exploring the Main Asteroid Belt, the gas giant planets and their moons, and the interplanetary plasma, eight are "powered" by sails made at Moonbase, and six were built entirely by Moonbase.

The Mass Driver

The most efficient form of transportation at Moonbase does not use rockets of any kind. It is the railgun, or *mass driver*, a form of electrical catapult.

The mass driver is used for lifting cargo off the lunar surface, mainly shipments of ore, oxygen, and refined metals that are used in the manufacturing facilities and space stations at LEO.

The English futuristic author Arthur C. Clarke first suggested that electrical catapults might be used on the Moon, nearly a century ago. By the 1970s, researchers such as Gerard K. O'Neill of Princeton University were developing the technology of mass drivers, and by the turn of the century work done at the University of Texas had produced a practical railgun system.

The Moonbase mass driver is located on Mare Nubium, approximately thirty kilometers from the outer rim of Alphonsus.

The mass driver is essentially a linear synchronous motor, a kind of electric motor that is laid out in a straight line. Electrical energy is used to accelerate the cargo-carrying "buckets" to lunar orbital velocity: 1.6 kilometers per second. By comparison, Earth's orbital velocity is 7.9 km/sec. In addition to the lower orbital velocity, the Moon is in vacuum and thus there is no air friction to hinder catapult launches.

If the energy required to boost a payload is expressed in terms of kilowatt-hours, then it takes approximately 11,000 kilowatt-hours of energy to lift a ton of payload from Earth's surface into LEO. To lift a ton of payload from the Moon's surface to escape velocity requires only 800 kilowatt-hours. In addition, Earth's thick blanket of atmosphere causes drag that must be overcome by further expenditure of energy, while the Moon is airless. The result is that payloads can be launched from the Moon to LEO twenty-two times cheaper than lifting them from the Earth to LEO.

The mass driver is 3.5 kilometers long. The cargo carriers are levitated along its track by powerful magnetic fields and accelerated at more than 100 *g*. Clearly, the mass driver is *not* used for launching people!

The magnets used in the mass driver are superconducting. They are composed of a niobium-titanium alloy. Although titanium is available on the Moon, the magnets were manufactured on Earth completely from terrestrial materials and transported to Moonbase in 150-ton segments. The entire mass-driver facility totals 20,000 tons.

Superconducting magnets require cryogenic temperatures, which are maintained with liquid helium. Although it is much easier to maintain such low temperatures on the Moon's surface than on Earth (vacuum is an excellent insulator), still some helium is lost over the course of a year's operation and

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must be made up by importation from Earth.

A second mass driver is now under construction, using aluminum magnets kept at cryogenic temperature by liquid oxygen. While cryo-aluminum magnets require a constant input of electricity, Moonbase's electrical power supply is now more than adequate to the task, and the cryo-aluminum magnets—as well as all the other components of the new mass driver—are being constructed entirely from lunar materials.

The mass driver regularly launches between five and six million tons of material each year to the facilities in LEO, at a cost of less than US$10 per ton.

The cargoes launched by the mass driver are collected by the mass-catcher in high lunar polar orbit, and from there are trans-shipped to LEO by nuclear-powered freight carriers.

Originally it was planned to place the mass catcher at the L2 libration point, above the Moon's far side. But because of the extremely sensitive radio telescope searches for extraterrestrial signals being conducted at Star City, the mass catcher has been established in a high polar orbit that circles the Moon in slightly more than two and a half days at an altitude of 50,000 kilometers.

Crossroads of Space

As lunar propellants, construction materials, and ores became more and more important to space industries and exploration, Moonbase—with its L1 space station—has become the nexus for the vast majority of space missions.

The LEO space stations are still an important first staging area for personnel from Earth who are going into space. But today most of the propellants and construction material for space missions come from Moonbase and its associated mining and manufacturing centers. Most of the spacecraft for missions to Mars, the Asteroid Belt, and beyond are actually constructed at the L1 station.

Thanks to its strategic position and its natural resources, the Moon has become literally the hub of the solar system.

The continuing exploration of the planet Mars is supplied from Moonbase. Outward-bound Mars spacecraft are assembled and checked out at L1. Returning Mars spacecraft come to L1 for repair and refurbishment.

The growing stream of prospecting vehicles heading for the Main Asteroid Belt, between Mars and Jupiter, are built at the L1 facility from metals and plastics manufactured at Moonbase. Increasingly, their electronic systems are manufactured at Moonbase, as well. Naturally, their propellants and life support supplies are provided by Moonbase. Of the eight Belt spacecraft launched in the past two years, only the nuclear reactors have been built on Earth: Moonbase supplied all the other components, equipment, and supplies.

The Solar Power Satellites, which beam energy to the Earth from geosynchronous Earth orbit (GEO), were built almost entirely from lunar materials. Moonbase Inc. is currently negotiating with the governments of Japan, India, and Brazil for construction of three new

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10,000 megawatt Solar Power Satellites.

Asteroid Mining

More than 100,000 asteroids have been detected in the Main Belt, and their orbits calculated. The largest of them, Ceres, is roughly 800 kilometers in diameter. Asteroids down to diameters of approximately one kilometer have been observed from the Moon.

The Main Belt asteroids are an incredibly rich source of metals and minerals. Although they lie beyond the orbit of Mars, the Main Belt asteroids contain the heavy metals and volatiles that the Moon does not.

About ninety percent of them are of the stony variety, relatively low in heavy metals but rich in volatiles, including water in the form of hydrates. The metallic asteroids, although fewer in number, still represent an enormous supply of iron, nickel, chromium, platinum and other precious metals.

Studies of asteroids undertaken with automated and teleoperated unmanned "prospector" spacecraft have shown that a single stony asteroid of the carbonaceous chondritic type, some 100 meters in diameter, contains hundreds of millions of dollars worth of organic chemicals and volatiles. A 100-meter-wide metallic asteroid contains nearly four million tons of high-grade nickel steel.

The 100,000 Main Belt asteroids identified so far represent more metal and mineral wealth than the entire planet Earth can yield. Astronomers calculate that there are trillions of smaller asteroids that have not yet been catalogued, ranging from a few hundred meters in diameter to the size of pebbles.

For this reason, Moonbase is devoting a major effort to exploring the Main Belt, designating the richest and most accessible asteroids, and preparing the necessary equipment and personnel to operate in the Main Belt for periods of up to three years. The Transportation and Mining Program Offices are jointly managing this effort.

The Quest for Water

Since no water has been found on the Moon, the search has been expanded to other bodies of the solar system.

The planet Mars has extensive ice caps of frozen water. Martian exploration teams use this resource for life support on the planet's surface. However, the energy required to land on the surface of Mars is more than double the energy required for landing on the Moon. (Mars's escape velocity is 5.03 km/sec; the Moon's, 2.38.) And once on the surface, the spacecraft must then take off again. The economics dictated by these energy requirements makes importing water from Mars very nearly as expensive as importing water from Earth.

Mars's two small moons, however, are relatively rich in water. They apparently were once free-roaming asteroids that fell into Mars's gravitational "well" and were trapped into orbiting the planet. Detailed studies have shown that Deimos and Phobos are similar in composition to carbonaceous chondritic asteroids. More than fifteen percent of their total masses consist of water,

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chemically locked to the rocks in the form of hydrates. This amounts to 10^{15} tons—a million billion tons—of water!

Because the Martian moons are so small (Phobos is 28 kilometers long, Deimos 16) their gravitational fields are negligible. Escape velocities are 0.016 and 0.008 km/sec, respectively. Therefore it would be much cheaper, in terms of energy and economics, to "mine" water from Phobos and Deimos than any other source yet found in the solar system.

However, the International Astronautical Authority has not permitted any economic or industrial utilization of the planet Mars or its satellites. Despite repeated appeals by Moonbase Inc., several of the governments that are principal shareholders in Moonbase, and the government of the Soviet Union (on behalf of Lunagrad) the IAA has maintained the position that *no* utilization of Mars or its moons may be permitted until the current scientific exploration of the planet definitely establishes whether or not living forms exist or have existed on Mars.

Consequently, Moonbase is considering two other possible sources of extraterrestrial water: asteroids and comets.

Asteroids. While most of the asteroids are in the Main Belt between Mars and Jupiter, nearly one hundred asteroids follow orbits that take them much closer to the Sun and across the orbit of Earth. The *Apollo* group of asteroids all cross the Earth's orbit. A smaller group, the *Atens*, orbit between the Earth and the Sun. The *Amor* group are farther out and cross the orbits of both Mars and Earth. These bodies are called near-Earth asteroids (NEAs).

Automated and later manned missions to the twenty nearest NEAs have shown that three of them are carbonaceous chondrites and contain between 15 and 20 percent water, in the form of hydrates. Although the IAA has prohibited activities on NEAs except basic research, Moonbase Inc. expects this ban to be lifted on at least one NEA within the coming year. At that time, manned operations on asteroid 2100 Ra-Shalom will begin the process of water extraction on an experimental basis. All other NEAs will remain off-limits to all operations except research.

Comets. Long described as "dirty snowballs," comets are bodies of frozen volatiles such as water, oxygen, nitrogen, etc., in which are mixed stones of various sizes. Most comets come close enough to the Sun to be seen from Earth and the Moon only once, then swing out on parabolic orbits that carry them away from the solar system forever. Other comets have less eccentric orbits and return to the Earth/Moon vicinity regularly. The most famous periodic comet is Halley's, which is due to return to the inner solar system in the 2061/62 time frame.

Dozens of other comets return close to the Sun regularly, in periods far shorter than Halley's. Since 1985, when the first spacecraft investigation of Comet Giacobini-Zinner was made, it has been evident that comets contain abundant amounts of water and other volatiles that are relatively lacking or altogether absent on the Moon.

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Halley's Comet, for example, spewed more than 30 million tons of water vapor into space during the six months of its approach to the Sun in 1985-86. While it was closest to the Sun, the comet lost an average of three tons of water per second. Halley's twenty-kilometer-long nucleus of dust and ice shrank by some six to nine meters during its last visit to the inner solar system. At that rate of loss, it still contains enough ice for thousands of more orbits.

However, even the comets that regularly return to the Earth/Moon vicinity rarely come closer than a few tens of millions of kilometers. Moreover, they are traveling at relatively high speeds in orbits of high inclination, rather than in orbits that lie nearly parallel to the Earth/Moon orbital path. This means that reaching them requires considerable expenditures of energy, rocket propellants, and money.

Moonbase has constructed and begun to operate an unmanned, highly-automated, teleoperated "scooper" vehicle that plies the inner solar system and maneuvers itself into the streaming tails of periodical comets whose orbits are of relatively low inclination. These tails are so tenuous that they are blown by the solar wind away from the Sun no matter which direction the comet is moving. They consist of gases and dust boiled off the comet's main body as it nears the Sun.

The scooper spacecraft, as its name implies, gathers up some of the cometary tail gases by use of an elongated magnetic field shaped like a funnel. The magnetic field is carried by thin rigid wires, which are possible only in the near-zero gravitational conditions of interplanetary space and the very low accelerations of the spacecraft's electrical propulsion system.

The lightest gases (hydrogen and helium) are used as propellants for the spacecraft's nuclear-powered electrical thrusters. Oxygen, nitrogen, and compound gases such as water, ammonia (NH_3) and methane (CH_4) are separated and stored in tanks aboard the scooper craft. Transfer tankers are sent out to the scooper when it is at its closest approach to the Moon, and take on the accumulated riches gathered from the cometary tails.

At that time, the scooper craft is refurbished, any necessary repairs are made, and new scientific instrumentation is installed for the continuing study of comets, the Sun, and the interplanetary medium.

The scooper spacecraft can also be programmed to intercept Sun-grazing comets which enter the inner solar system only once. Some grazers do not survive their close encounter with the Sun; they are completely boiled away or, on rare occasions, actually crash into the Sun itself.

Scooper spacecraft are still operated on an experimental basis. The amounts of water and volatiles that they have provided for Moonbase are small, but well within the expected parameters of these early test flights. Within five years scooper spacecraft should be able to provide Moonbase's entire current requirement for water and volatiles.

The Quest for Intelligent Life

Although there is a vigorous bio-

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chemistry underway beneath the clouds of Jupiter, to date no trace of extraterrestrial intelligent life has been found in the solar system. The radio searches of the sky being conducted at Star City have detected some faint signals that are possibly the work of an intelligent species, but this conclusion has not yet been confirmed.

Moonbase is working with a consortium of universities and government agencies on Earth to construct the first interstellar probe spacecraft. Unmanned, fully automated, and under the guidance of the latest artificial intelligence (AI) computer systems, the three probes now under construction will be sent to Alpha Centauri, Barnard's Star, and Wolf 359, the three stars closest to our solar system. Planets have been observed orbiting around Barnard's Star and Wolf 359. One-way trip times are expected to be between fifty and seventy-five years.

Much of the propulsion and electronics technology for these first star probes has been developed at Moonbase. The magnetic scoops that the star craft will use to gather interstellar hydrogen to fuel their fusion engines are based on the scoops developed for Moonbase's comet scooper spacecraft. The AI systems are refinements of the decision-making, self-repairing systems developed over two decades of lunar surface and space operations.

These automated probes to the stars will undoubtedly be followed by human explorers one day. When that time comes, the star ships will be built at Moonbase, and their crews will include many of Moonbase's finest men and women.

MOONROCKS AND DIAMONDS: LUNAR MANUFACTURING

When men and women first returned to the Moon, around the turn of the century, hardly anyone thought that the Moon would become a major manufacturing center. Yet that is exactly what has happened.

It was expected that lunar oxygen would play an important role in the economics of space transportation. And so it has. But other lunar resources, including the resourcefulness of our people, have allowed Moonbase to develop a unique and highly profitable manufacturing capability.

The Moon has three significant advantages for manufacturing:

1. *Natural Resources*. Oxygen, silicon, aluminum, iron, titanium, calcium, and magnesium are all abundant on the Moon. For the most part, they are available on the lunar surface, as part of the regolith or in rocks ejected from meteorite impact craters and/or volcanoes. There is hardly any need to dig deep into the Moon's crust, as most mines are dug on Earth.

2. *Low Gravity*. The Moon's low gravity has two beneficial effects. First, it allows lunar raw materials to be lifted off the Moon and sent to factories in LEO or elsewhere very cheaply. It takes only 800 kilowatt-hours of energy to lift a ton off the Moon.

Low gravity is useful not only for transport economics, but in manufacturing as well. Structures can be built more lightly on the Moon. Delicate work, such as thin films and large pieces

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of glass, can be manufactured to precise tolerances without being warped, bent, or cracked by the strain of gravity. The 1,000 centimeter optical telescope mirror at the Star City observatory was manufactured on the Moon mainly because it could not have been made on Earth.

Low gravity affects the economics of any operation that involves lifting or transporting materials from one place to another. "Trucking" on the Moon is much less expensive than terrestrial hauling; lifting requires only one-sixth the work it does on Earth.

3. *High Vacuum.* While the Moon's airlessness poses problems for life support, it is a very valuable commodity for manufacturing processes.

On Earth, factories and research laboratories spend a great deal of time, energy, and money to produce nothing—a vacuum. On the Moon, vacuum is everywhere, for free.

The unit of measurement for vacuum is the *torr*, named after Evangelista Torricelli, the student of Galileo who first measured air pressure and invented the barometer. On Earth, standard air pressure at sea level is 760 torr.

Vacuum has many industrial applications. On Earth, vacuums of 10^{-4} torr are used in metallurgical processes such as casting, sintering, heat treatment and brazing. The pharmaceutical and food industries also use such vacuums in freeze-drying medicines, antibiotics, blood plasma, and foodstuffs. Vacuum down to 10^{-6} torr is used for insulating cryogenic liquids at temperatures close to absolute zero, electrical insulation, vacuum tubes, thin-film coatings, and electron welding.

Research applications of vacuums down to 10^{-9} torr include electron microscopes, particle accelerators, microwave tubes, field ion microscopes, and thermonuclear fusion reactors.

It is possible to produce on Earth a vacuum as low as 10^{-11} torr. To do this, however, takes special equipment and many hours of pumping work. The vacuum chamber is usually quite small, volumes of only few cubic meters, at most. On the lunar surface the vacuum is ten times better, 10^{-12} torr, over the entire expanse of the Moon—an area of some 38 million square kilometers, nearly equal to the land area of North, Central and South America combined!

Since the advantages of low gravity and vacuum are also available at LEO (plus the availability of near-zero gravity) most planners originally felt that the Moon would be used mainly as a source of raw materials while factories and industrial facilities would be built in orbit close to the Earth. That was before Moonbase was started. Today, Moonbase is not merely a "mining town"; it is a prime industrial center.

The Economic Imperatives

The first "mining" operations carried out on the Moon were simply to scoop up the topmost layers of the regolith and cover the habitation modules of the earliest camps with the rubble. A thickness of two meters was considered necessary to protect the living and working spaces from solar radiation.

Since lunar oxygen was a key to the

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economic viability of Moonbase, the first Lunox facility was put into operation by 2005, although it did not attain its full production capacity until more than a year later.

Even before Moonbase was started, however, studies had shown that it should be possible to use native lunar materials for construction on the Moon, and even for export to space stations and factories in LEO. In addition to oxygen for life support and rocket propellant, lunar metals could be used for construction of new facilities and spacecraft in orbit and raw lunar ores could provide radiation shielding for manned space stations in GEO, where Van Allen Belt radiation fluxes are hazardous.

More important, though, in those early days was the use of native lunar materials in building Moonbase itself. During the bootstrap years, every gram of native materials that could be used meant a gram that did not have to be imported from Earth. This had a direct and very powerful influence on the economics of Moonbase and the growth of its facilities.

As in all other aspects of Moonbase's operations, the goal of our Mining and Manufacturing Program Office is self-sufficiency. Today, Moonbase manufactures all its own glass, metal, and concrete building materials, including fiberglass products, together with virtually all the optical, electronic and mechanical equipment for our research and manufacturing centers. In addition, the L1 space station has become a major manufacturer of spacecraft for deep-space missions.

Moreover, Moonbase exports to LEO and directly to Earth itself a variety of manufactured products, including refined ultrapure metals and alloys, fiberglass and metal honeycomb insulation materials, electronics components assemblies, ceramics, plastics, construction materials, and a small but growing trade in lunar diamonds and other gemstones.

Lunar Factories

While many critics on Earth argued that Moonbase should merely serve as a source of raw materials, which should be shipped to LEO facilities for refining and manufacturing, Moonbase Inc.'s management decided very early that shipping finished manufactured goods cost less in transportation and brought higher prices at the markets in LEO and on Earth. Thus the drive to build up a manufacturing capability had solid economic reasoning behind it—providing that most of the manufacturing equipment could itself be built on the Moon from lunar materials.

Not only was this possible, it was necessary.

Manufacturing at Moonbase made little economic sense if most of the basic equipment—jigs, fixtures, machine tools, etc.—has to be hauled up from Earth. Moreover, because of the unique environmental conditions on the Moon, lunar factories are very different from their terrestrial counterparts. The proper equipment for a lunar factory does not exist on Earth.

Lunar factories are mostly "out in the open," up on the surface. They are al-

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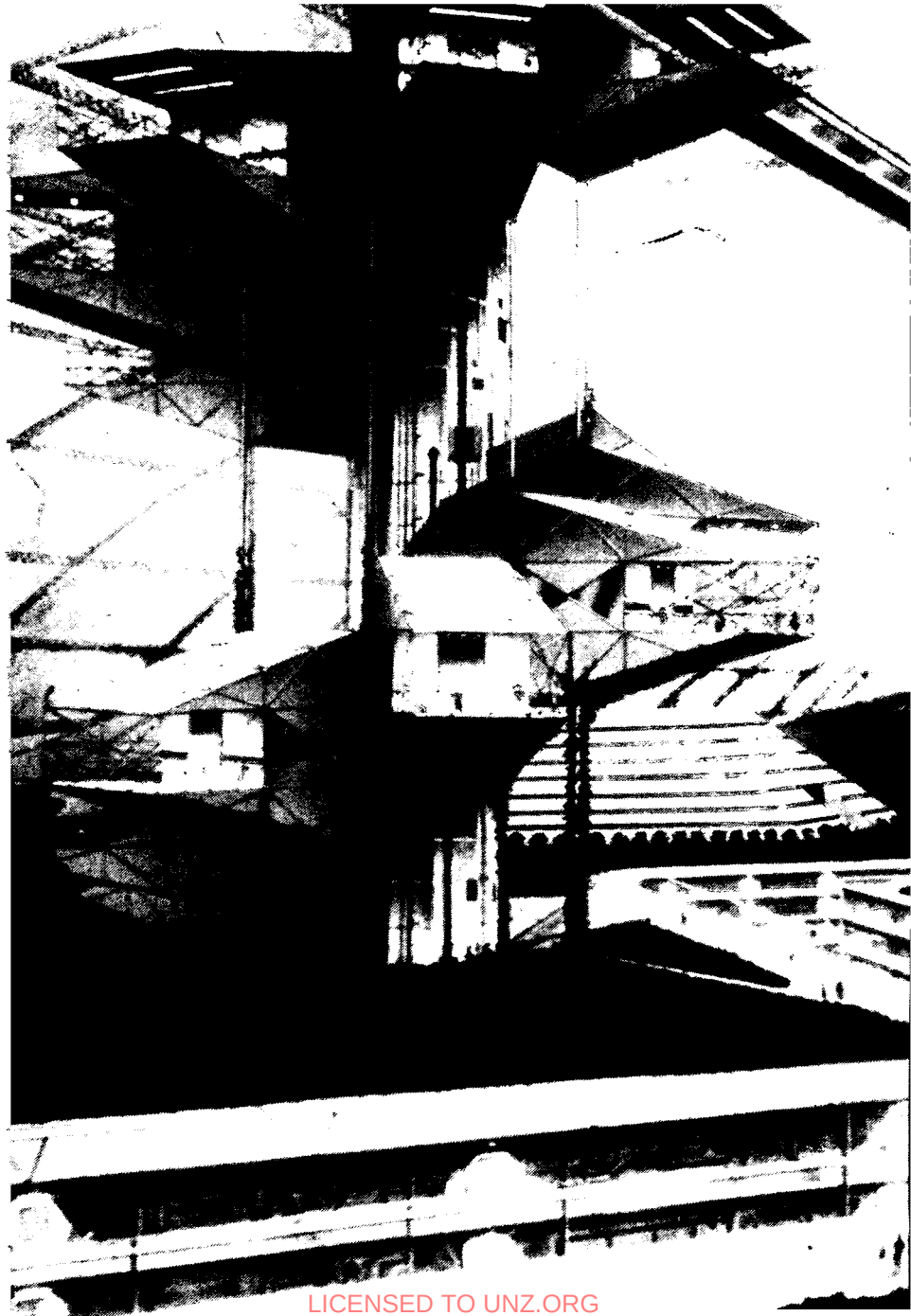

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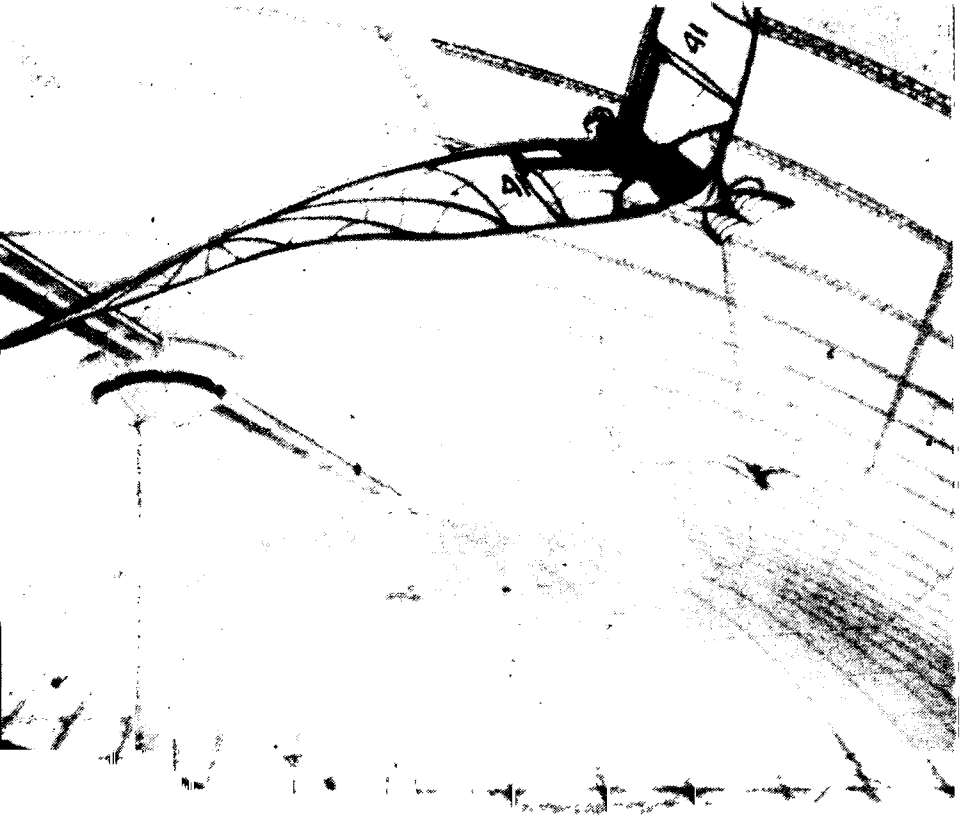

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most completely automated. The few machines that do not run under automatic, computer-directed control are teleoperated by human directors whose control stations are safely underground. The factory interiors are open to vacuum, except for small specialized areas where air is deemed necessary or desirable.

Newcomers to Moonbase often find it difficult to accept the idea that vacuum is a *beneficial* environment for most industrial operations. They instinctively regard vacuum as dangerous; and so it is—to humans. To properly-designed machinery, including robots, vacuum can be extremely benign, largely because it is extremely *clean*.

Contamination is something that terrestrials (human beings who have always lived on Earth) take for granted. On a planet teeming with life from bacteria to whales, thick with pollution from human and natural sources, and deeply within a turbulent atmosphere that transports spores, dust, pollen, smog, moisture and other pollutants all across the globe, cleanliness is a matter of degree.

In the 10^{-12} torr vacuum of the lunar surface, cleanliness comes virtually free. Not only is the environment free of external pollution sources, the contaminants *inside* materials can be removed quite easily. Metals, for example, usually have a certain amount of residual gases trapped inside them. In the one-trillionth of a torr environment of the Moon, these gases seep out of the metal's crystal structure and boil off into space. This process is called *degassing*.

Thus Moonbase's factories are open to vacuum. They are built on concrete pads atop the regolith and domed over by meteor shields of lunar honeycomb aluminum to protect them from the infall of microscopic meteorites. The largest source of contamination in these factories comes from the humans who must occasionally visit the facilities to do repair, maintenance or alteration work that the robots are incapable of. All human factory workers must wear pressure suits, of course, in the airless areas. In addition, humans must enter the factory through special decontaminating airlocks, in which electrostatic "scrubbers" remove all particles of dust or dirt on the outside of their suits and special powdered detergents are applied to the suit exteriors to remove all traces of oil, perspiration, and other contaminants. Then the airlock is decompressed and the visitor waits in vacuum for a predetermined time before the hatch to the factory proper is unsealed. Some workers refer to the decontamination airlocks as "the car wash."

No human visitors are allowed to enter a factory area except through the decontamination airlocks. Each factory's security robots are programmed to prohibit visitors who try to enter a factory from the dusty regolith.

Welding and Metalworking

Another advantage of vacuum is that metals can be "cold welded." Ultraclean and degassed metals can be permanently joined merely by holding them together, without the need for heat. Metals that self-weld easily are those with relatively low melting temperatures, including aluminum, tin, zinc,

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copper, nickel, iron and silver. Self-welding can be a problem, however, when two pieces of metal that are not meant to be joined are accidentally brought together!

For other welding purposes, electron beam welding equipment is used. On Earth, electron-beam welding is expensive and difficult because it must be done in a vacuum chamber. On the Moon, electron-beam welding is as commonplace as acetylene-torch welding is on Earth.

Metals that are difficult to shape or machine on Earth can be worked quite easily in lunar vacuum, mainly because such metals become stronger and less brittle once their contaminants have outgassed. Many ores can be refined by heat alone, without the need for exotic chemical treatments.

Closed-Loop Manufacturing

One further difference between lunar and terrestrial factories is the matter of waste-handling and pollution.

On Earth, for thousands of years people have tended to dump their wastes in nearby streams and allow the smoke from their fires to drift away on the breeze. Only in the past century has environmental pollution become a vital terrestrial issue.

On the Moon, with no streams or air, waste-handling has been important since the very beginning of human occupation. Because all human habitats on the Moon *must* be self-contained, closed ecological systems, waste-handling is literally a matter of life and death.

There is also a practical, economic side to the problem of waste-handling and pollution. Since about 90% of human waste is water, it is essential to recover and recycle this most precious resource. In addition, because it was quite expensive to bring equipment and supplies from Earth, Moonbase's habitats and facilities were designed from the very beginning to recycle or otherwise utilize as many of their waste products as possible.

For example, as a byproduct to its oxygen output, the earliest Lunox facility produced a considerable tonnage of powdered iron and titanium oxide. This was not merely dumped on a waste heap; the metals were used as building materials for the construction of Moonbase and its outlying facilities. To this day, Moonbase's metal refineries are fed in large part by the "garbage" from the Lunox plants.

This is called "closed loop manufacturing," and it is essential to Moonbase's economic viability.

Raw Materials

Raw materials for lunar manufacturing come from three main sources:

1. *Lunar Ores* are strip-mined from the regolith. Both rocks and fines (powdered soil) are used. The major elements found in the regolith are oxygen, aluminum, silicon, titanium, iron, calcium, and magnesium. Useful amounts of boron, gallium, potassium, phosphorus, and rare earth elements have also been found. Metals heavier than iron are extremely rare, except in scattered sites of meteor strikes.

Lunar ores are the raw materials for production of glass, fiberglass, ceramics, semiconductors, concrete, metal

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sheets and beams, honeycomb metal sheets, and composite materials such as boron-fiber-reinforced ceramics.

2. *Earth imports* consist mainly of hydrogen and organic chemicals such as nitrogen and carbon, all of which are almost totally lacking on the Moon. A small amount of these three elements are available from pockets of ammonia (NH_3) and methane (CH_4) trapped beneath the floor of Alphonsus.

Hydrogen is necessary as feedstock for oxygen and water production. Carbon and nitrogen are vital for agriculture and life support, as well as inputs to certain manufacturing processes. The carbon reduction process, for example, is used to produce semiconductor materials for electronics systems and optical quality glass out of raw lunar silicon.

3. *Lunar grown* resources include most of the food grown in Moonbase's farms and an increasing amount of organic waste material. Limited only by the available supply of water, lunar agriculture/aquaculture not only feeds the population of Moonbase but provides feedstock for manufacture of plastics and pharmaceuticals. Moonbase provides most of the food for manned deep-space missions, and food exports to LEO stations are increasing each year.

A fourth source of raw materials, *imports from other bodies of the solar system,* is a small but growing part of Moonbase's economy. Water itself, as well as organics such as carbon and nitrogen, are available in comets. Metals, minerals, and organics exist in staggering quantities in the asteroids. At present efforts to use these resources are in their infancy. However, as more of Moonbase's resources are obtained from the comets and asteroids, imports from Earth will dwindle.

Integrated Manufacturing

No single manufacturing effort at Moonbase operates by itself. Every manufacturing cycle and facility is integrated into a carefully coordinated system that takes into account economic efficiency, raw material requirements, integration with other processes, output markets, manpower, productivity, recycling and waste handling.

Moonbase's manufacturing facilities are fully integrated to produce oxygen, water, various types of glass, metals, ceramics, construction materials, electronics components, and reinforced composites. Following the flow of inputs through the various manufacturing processes:

1. Undifferentiated lunar ores are screened, heated, and separated. Ilmenite is shunted to the Lunox facility, where it is put through the hydrogen reduction process to yield water and oxygen. The remaining iron and titanium oxide are sent to the metals refinery.

2. Ores other than ilmenite are moved by conveyor belt to a second separator. Fines are sent to the solar furnace facility where silicon is extracted for processing into glass products (insulation, building bricks, containers, tiles, etc.). Some of the glass, while still molten, is drawn off for use in the high-quality optical glass manufacturing facility.

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Metallic elements in the fines are sent to the metal manufacturing facility.

3. Rocks are compacted into powder and separated into their constituent metals and silicon. The silicon is routed to the glass factory, while the metals are processed by several methods (including electrolysis and heating in a solar furnace) into castings, sheets, fixtures, etc. The iron and titanium oxide byproducts of the Lunox facility and the metals rejected from the fines used in the glass factory serve as additional inputs here.

4. Rare elements such as boron and gallium are extracted from the ores and routed to the specialized facilities for manufacturing electronics components and composite materials.

5. Energy inputs for all processes are provided either by electricity or by heat. Electricity is generated in the solarvoltaic farms, with backup power available from nuclear reactors. Approximately half the electrical power generated by the solarvoltaic farms is stored in superconducting coils during the day, for use during the long night when the solarvoltaic cells are inoperative.

Heat is obtained directly from sunlight during the lunar day. Solar furnaces, consisting of mirrors that focus unfiltered sunlight, can create temperatures at their focus of several thousand degrees. Solar furnaces are inoperative during the lunar night.

6. Waste heat created by any individual process is either radiated into the vacuum or recycled for use as energy input to other processes. Careful utilization of waste heat during the 350-hour lunar night allows manufacturing processes to go on with only a small portion of the lost solar heat made up by standby electrical furnaces.

Lunar Construction Materials

Concrete is an excellent construction material. It is strong, fireproof, and can be made in almost any desired shape. In the one-sixth gravity of the Moon its strength-to-weight ratio makes it superior to most metals for construction purposes. Moonbase's Main Plaza vault, the platforms for the factories and spaceport, and much of the underground flooring and airtight bulkheads are made of lunar concrete.

Concrete is a mixture of cement and "aggregates": that is, small pieces of rock and sand. On Earth, water is an essential ingredient for cement. Rock and sand (fines) are plentiful on the Moon. Moonbase produces *waterless* cement entirely out of lunar resources. The ingredients are phosphates and anorthite from highland regolith. Lunar anorthite ($CaO.Al_2O_3.2SiO_2$) is low in calcium content for concrete formulations, but when heated to 3000°C (5432°F) in the presence of phosphate ($Ca_3[PO_4]_2$) its calcium content can be enriched to approximately 50% by weight.

Phosphates are not abundant on the Moon, but the phosphate consumed in the reaction can be regenerated by heating the phosphorus byproduct of the cement reaction with pyroxene from maria regolith.

Glass is another useful and versatile material. Glass of every type—from

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building bricks to crystal to the finest optical quality—is produced at Moonbase from lunar silicon and solar heat.

While manufacturing glass bricks and tiles for construction purposes is a fairly straightforward operation, two special applications of glass have been developed at Moonbase that cannot be duplicated on Earth: large optics and Glassteel, a transparent glass with the structural strength of steel.

Glass is essentially a liquid that solidifies at normal room temperatures. It is produced in the molten state, a mixture of silicon and other elements introduced to control the final quality, color, strength, etc. of the finished product. It is also shaped while molten, and then allowed to cool until solid and finished. On Earth it is extremely difficult to build large structures of glass—especially if they must be polished to an astronomically-accurate smoothness, as a telescope mirror—because Earth's gravity deforms the glass while it is still molten and may even crack the finished piece.

In the one-sixth gravity of the Moon it is possible to make much larger glass pieces of much higher purity and smoothness.

Moonbase has developed a simple process for manufacturing large optical-quality glass. Instead of making a telescope mirror, for example, and then grinding it for months to produce the necessary microscopic smoothness, a metal mold for the mirror is built and polished to the desired smoothness. The mold is allowed to degas in vacuum until it is ultrapure. Then molten glass is injected into the mold and allowed to cool and degas under controlled conditions.

Using this simple process Moonbase has produced the main mirror for the 1,000-centimeter optical telescope at Star City, the telescope that has detected planets orbiting Barnard's Star and Wolf 359. Smaller optical components are an increasingly important export item. Moonbase Inc. is currently negotiating a contract to mass produce specialty lenses for Minolta Camera Co., Ltd., of Osaka.

The sweeping windows of Moonbase's main vault that offer such a breathtaking view of Alphonsus are made of Glassteel manufactured at Moonbase. Strong as the concrete of the vault, yet transparent as crystal, this glass/metal mixture could not be made on Earth.

Semiconductors, Ceramics and Plastics

A world that is 43% silicon dioxide should be a good place to manufacture electronics components, such as silicon-based semiconductors. Add a better vacuum than any obtainable on Earth, and it is obvious that the Moon has the perfect environment for manufacturing transistors and other electronics "chips."

Indeed, Moonbase manufactures all its own electronics components and systems, and silicon-based semiconductors became one of Moonbase's early export products. Today, improved electronics components based on gallium chips are replacing the silicon products.

In the clean vacuum of the Moon, microscopic-sized electronic chips are

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manufactured in automated facilities. The technique of depositing the electronically-active material on a chip in a thin film has been refined to the point where the film may be only as thick as a single molecule.

Silicon in the regolith is still used to manufacture solarvoltaic cells that convert sunlight directly into electricity. Solar-energy farms spread over considerable portions of Alphonsus's floor and the "shore" of Mare Nubium, outside the ringwall mountains. Mobile, automated solar-cell factories mounted on specially-modified crawlers continuously add new sections to the energy farms, converting the regolith ore into finished solarvoltaic cells and connecting them to Moonbase's electrical power grid.

Silicon and heat from solar furnaces are also used to manufacture a growing range of ceramic materials. Ceramics are used within Moonbase for piping, heat exchangers, storage tanks and structural elements such as bricks. Because refractory ceramics can withstand high temperatures, they make excellent insulating materials, including spacecraft heat shields and even rocket nozzles, when combined with special metal alloys.

Such metal-ceramic mixtures, called *cermets*, are difficult or impossible to produce on Earth. They can best be manufactured in the near-zero-gravity environment of an orbiting space station. Moonbase's materials scientists and engineers have developed techniques for manufacturing cermets in one-sixth gravity at costs considerably lower than those incurred at LEO. Plans are underway to test a pilot-plant facility in the L1 station that would combine the advantages of microgravity with lower raw-material costs.

For almost the first full decade of its existence, Moonbase's two largest imports from Earth were food and plastic sheeting. The plastic was necessary mainly to provide airtight seals in areas where people lived and worked. Plastic sheets were heat-bonded together and attached to rock or structural walls to form airtight barriers against the vacuum.

The development of lunar agriculture helped ease the need for such imports. Not only did the farms provide a constantly-increasing percentage of the food at Moonbase, they provided the raw material for manufacturing plastics. Special sections of the farming areas were set aside for crops such as soybeans that could provide both high-protein nutrition for people and animals, and feedstock for the fledgling plastics manufacturing facility as well.

Plastics have many uses. Temporary shelters are made of plastic tents reinforced with wire mesh to withstand the load of radiation-shielding rubble placed atop them. Mirrors of enormous size are made of plastic sheet spray-coated with lunar aluminum, to make them reflective. The only communications satellites allowed to orbit the Moon are passive balloons made of aluminized plastic that reflects microwave radio beams; these satellites are completely radio-quiet on the far side, where radio noise would interfere with the search for

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signals from extraterrestrial intelligence.

Lunar plastics, ultrapure because they are manufactured in vacuum, are also used for the *solar sail* spacecraft that drift outward through the solar system, pushed by the pressure of sunlight, carrying scientific instruments for studying the planets and their moons, the asteroids, and the interplanetary medium.

Sandwiches and Diamonds

Two other lunar products are important to Moonbase's economy: metal honeycomb sandwiches and gemstones.

Metal honeycomb "sandwiches" were first developed nearly a century ago, on Earth. Two sheets of metal are separated by a honeycomb of thin metal walls that trap pockets of air inside them. Honeycomb sandwiches can be very thin and light, yet have the structural strength of much thicker sheets of metal. They were widely used in aircraft and spacecraft construction as early as the 1960s.

In space, honeycomb sandwiches can be produced in which the pockets between the sheets are no longer filled with air, but with vacuum. This makes the honeycomb an excellent insulator against heat or cold, as well as a strong lightweight material.

Moreover, in low gravity honeycomb materials can be made of metal "foams," in which molten metal is bubbled with gas, then rolled into sheets and allowed to degas in vacuum. Not only can this be done with metals: honeycomb sandwiches have been produced at LEO and Moonbase from pure ceramics, cermets, ceramic-plastic combinations (called *cerplasts*), glass, and metal-glass combinations.

Moonbase's gemstones come from two sources: natural and man-made.

The Moon has been bombarded by meteorites since the very beginnings of the solar system. Some of these meteorites contain natural diamonds—pure crystallized carbon—within them. The first lunar diamond was discovered by a research technician who was sawing open a meteorite fragment that had been found on the surface of Mare Nubium. When her diamond saw snapped, the technician was stunned to find that a small glittering object embedded in the meteorite had broken it. The object was a perfect blue-white diamond, one-tenth of a carat in weight.

The Moon is literally covered with such gemstones—albeit sparsely. A popular pastime for tourists and Moonbasers alike is to go "diamond hunting" on the surface. There are real diamonds mixed into the regolith, and they are much easier to find than on Earth (although still it is not truly easy).

Gemstones are also grown at Moonbase. Crystals grow larger and more easily in low gravity than on Earth. At Moonbase, small chips of diamond are used as "seeds" to grow industrial quality and even gem-quality stones. Methane is passed over the seed chips at a temperature of 2000°C. The gas decomposes into hydrogen (which is used elsewhere) and *monatomic* carbon—individual carbon atoms—which deposit themselves on the seed chip and literally grow into large diamonds. The process is greatly facilitated by the clean

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conditions of lunar vacuum, the low gravity, and the absence of vibration. (The gemstone facility is built on special shock-absorbing mounts to guard against even the slightest moonquakes.)

Diamonds, rubies, sapphires, and other precious stones are manufactured not only for jewelry; they are much more widely used in industrial machinery and in devices such as lasers. Other kinds of crystals for electronics chips and high-quality optical lenses are also manufactured at Moonbase.

The Competitive Edge

Moonbase has swiftly evolved from a "mining town" into a highly-advanced center for manufacturing.

As has happened in Earth's earlier history, the factories that depend on lunar resources can operate more economically if they are as close as possible to those resources. While factories at Moonbase cannot make use of zero gravity, for most industrial purposes one-sixth *g* is almost as good. In addition, Moonbase has zero-gravity conditions available at the L1 space station, where specialized manufacturing processes are located.

The tide of economic competition is strongly in favor of Moonbase. Manufacturing operations at LEO are migrating to Moonbase. At the current rate of change, within another decade LEO will be used only for those processes that absolutely require zero-gravity conditions. ■

IN TIMES TO COME

●Colonists on any new world are going to have to expect some unforeseen problems, and Robert R. Chase has concocted a doozey for next month's cover story, "The Changeling Hunt." When a colonist disappears, and a not-too-reasonable facsimile appears in his place, it's pretty clear what needs to be done—or is it? Getting the disappearee back would seem a quite obvious first step, and the nature of Chase's world makes that a peculiarly challenging task. But then there are the problems of whodunit and why. Once you understand the reasons for an unanticipated event, the appropriate response may be wildly different from what you thought—and no less difficult to carry out.

Our July issue also offers the conclusions of our two current serials, Harry Turtledove's *The Report on Bilbeis IV* and Ben Bova's less fictional *Moonbase Orientation Manual,* this time focusing on research and recreation on the Moon. Plus new stories by Charles Sheffield, Timothy Zahn, and W. T. Quick.

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SYNOPSIS

Chairman Paulina Koch was used to defending the Survey Service in the Assembly against charges of interfering on the pre-technological worlds in periodically examined. Having just done so yet again, she was not ready for the newly arrived report on Bilbeis IV, which showed serious interference had been committed: a local queen named Sabium, who had been cured of a cancer by Service personnel 1,500 years before, was still alive, and worshiped over a continent and a half as the undying goddess.

Halfway across the Federacy, on Hyperion, anthropology grad student Stavros Monemvasios was not ready to learn of that report either. He got it by chance: one of his professors, Isaac Fogelman, had accessed several newly arrived Survey Service reports from public files and assigned one to each student in Stavros's seminar group. When Stavros was done reading it, he knew he was sitting on a bombshell. He decided to keep quiet about it until the next meeting of the seminar.

Paulina Koch and her security chief Roupen Hovannis decided to erase the report on Bilbeis IV. They both saw the political damage it would do the Survey Service and the ammunition it would give the Purists, the faction that favored abandoning contact with primitive worlds precisely for fear that such interference would happen. That was when they discovered Stavros's professor had already accessed the document. He was the only one. They arranged to have him silenced, and his data storage system scrubbed. It went off without a hitch, and looked like a robbery-murder. Paulina Koch, a consummate bureaucrat, began forgetting the whole affair had ever happened.

Stavros found out about his professor's murder when he went to the seminar. He ended up showing his summary of the report on Bilbeis IV to Andrea Dubois, a girl in the class. She also recognized how important it was, and warned him to be careful about who saw it.

Van Shui Pong found out why: the Jêng Ho's *entire crew was missing and presumed dead in a starship crash. That convenient accident gave him a bad case of cold feet; he was afraid to stand against the Survey Service anymore. Stavros and Andrea decided to keep trying to drag out the truth, though he especially felt anything but heroic.*

Paulina Koch did not ask Roupen Hovannis anything about the crash: she did not want to know. She almost wished she had never started the concealment effort. Too late to worry about that now, though, if she wanted to stay out of rehabilitation.

Without Van Shui Pong, the ruckus Stavros and Andrea were able to raise diminished. People were getting bored with hearing charges that looked impossible to prove. But they kept on, until Hovannis hired the same quietly efficient assassin who had dealt with Fogelman to shut them up for good. One evening when Stavros came back from a late class, he found Andrea dead in his dorm room.

He did not go to the police; he was afraid they would blame him for her death. Instead, after a sleepless night, he turned his credit account to cash and headed for the spaceport to get offplanet. That complicated life for Hovannis's hired killer, who had finally and reluctantly decided Stavros needed erasing too.

Paulina Koch, the Survey Service appropriation safe and the investigation on Bilbeis IV quashed, began to worry about that killer. He was useful, but he knew too much.

Stavros bought a ticket for Topanga; maybe the Jêng Ho's *crew had talked to someone there or left behind information. Then he settled down to wait. His connecting flight would not leave for more than a day. He had shaved his beard, and hoped the flimsy disguise would keep him safe. It was a poor guarantee, but he was still a step ahead of*

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the hired gun who had thought at first that he would run for his home world. Then the killer figured out his mistake, and took along poison for a quiet, discreet murder.

Just before he found Stavros, though, he was himself quietly and discreetly killed by a hireling of Paulina Koch's—the Chairman had decided to tidy up the loose end he represented. Stavros took off on the Arminius, *bound for Topanga.*

A couple of days later, a newsnet reporter named Van Shui Pong came round to ask Stavros a few questions about his professor's death—he was curious that all of Fogelman's electronic files had been erased. Learning that made Stavros wonder if Fogelman's death had been part of a concealment effort. He showed Van Shui Pong the report. The newsnet man also recognized its potential for trouble. When he tried to access a copy to see if it was genuine, he found the computer had never heard of it. He also found that the Survey Service ship Jêng Ho, *which had filed the report Stavros was holding, was supposed to have arrived 18 days before—that information did not come from the same data base as the report itself. Van Shui Pong broke the story of the report and the effort to suppress it.*

Paulina Koch decided to hang tough, and to claim that the report on Bilbeis IV was a forgery: if the Service had no record of it, it could not be real. Electronically, she and Hovannis had fixed all the files now. The only real danger left was someone summoning the crew of the Jêng Ho *to testify. Even that might be manageable. Paulina Koch and Hovannis also decided to find out where Van Shui Pong was getting his information, with Fogelman gone.*

Stavros and Andrea, brought together by the seminar and by the report on Bilbeis IV, became first friends and then lovers. They watched in disbelief as Paulina Koch called a news conference to deny everything and blame the brewing scandal on a Purist hoax. Furious, they called Van Shui Pong to suggest that he get hold of the Jêng Ho*'s crew directly, to give the Chairman the lie. Stavros began to get the feeling he was in over his head.*

In the Assembly, Paulina Koch repeated the denials she had made at the news conference,. and invited its computer people to search her files—any damaging information was gone without trace. She blamed the discrepancy in arrival dates for the Jêng Ho *on computer error. The Assembly decided to subpoena the* Jêng Ho*'s crew from Topanga, to have them testify in person as to what they knew. Even the Chairman's opponents thought the prospect did not worry her.*

Magda Kodaly was in the shower when the phone chimed. She swore and stayed under the warm needle spray, hoping whoever was on the other end of the line would give up and go away.

Whomever it was had stubbornness to go with an exquisitely misplaced sense of timing. The chime kept ringing. Muttering under her breath, Magda turned off the shower, pulled her auburn hair back from her face so it would not drip in her eyes, and shrugged on the robe she had hanging by the stall. Let this idiot figure out what he'd interrupted, she thought—maybe he'd be embarrassed enough to hang up in a hurry.

The minute she clicked on the screen and saw she was face to face with Atanasio Pedroza, she knew she had made a mistake. She had turned aside the biologist's advances all through the mission of the *Jêng Ho*, but he had not given up even after the ship came back

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to the base here on Topanga.

Now he did not look embarrassed; he looked as though he was picturing her wet naked body under the robe. She pulled it together so it covered more of her, but that proved wrong too, because it drew his attention to her breasts.

"Hello, Atanasio," she said, sighing. "What is it?"

"Hmmm? I'm sorry, Magda, I was too busy admiring." Even his voice had a leer in it, the anthropologist thought with distaste. He was blond and handsome and more than competent in his field, but he never failed to set Magda's teeth on edge.

"*Will* you come to the point?" she snapped; patience had never been one of her long suits. She was also getting cold.

He looked hurt. "After we fought that report through together, I thought we might be able to get along better in other ways too."

"Don't get your hopes up." To give Pedroza his due, he had fought hard for an honest report. He had rigid standards of right and wrong, and the courage of his convictions. It was what he was like operating outside those convictions that made Magda dislike him. She said, "Just because we were able to work together once, Atanasio, doesn't mean I want to go to bed with you."

"I don't give up easily," he said. She grimaced. She knew that was true. Professionally, it was an asset; here, it was more a pain in the ass. He went on, "Soon I'll have a chance to try changing your mind under more pleasant circumstances than this semiconscious excuse for a planet offers."

Magda rather liked Topanga's relaxed pace of life, but that had nothing to do with the sharpness of her question: "What do you mean?"

"The whole crew has won a round trip to Carson Planet. Once a month here, they throw the names of all the incoming ships into the computer, and the *Jêng Ho* came out. Captain Brusilov delegated the arrangements to me."

That last sentence killed the pleasure the previous two had given Magda. She had been to Carson Planet before, and enjoyed it. The place specialized, not in industry or agriculture, but in no-holds-barred fun: "Everything in Excess" was the local motto. Not surprisingly, it was one of the richer worlds in this part of the Federacy. However—

"I suppose you booked the two of us into the same cubicle on the flight out," she said. She had intended it as sarcasm, but Pedroza refused to meet her eye. "You bastard, you didn't!"

"As a matter of fact, no," he said, flushing, but before she could be mollified he admitted, "You are in the one next to mine, and they do connect."

"You have your nerve. After the *Jêng Ho*, I'm not overjoyed being on the same planet with you, let alone the same starship—and being in the next cubicle is way, way too close. I'll stay here, thanks. Have yourself a good time."

"Everyone else I've gotten hold of is eager to go. We even got a credit advance to gamble with."

"I—don't—care." She spaced the words from between clenched teeth. "Now will you get off the damn phone and let me finish my shower?"

"I'll send the tickets and such over to you, in case you change your mind."

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He blanked the screen.

"Not bloody likely," she muttered. She took off her robe, flung it against the wall, and got back under the water. It did not wash away her foul mood, which was not helped by finding that Pedroza was as good as his word: a ticket for the tour ship *Clark County*, a reservation at one of the better Carson Planet hotels, and notification of her credit advance were sitting in the fax slot. She scowled at them, wishing Pedroza was less stubborn, or at least that he would find someone else to pursue.

She dressed in a hurry and took a shuttle to the Survey Service field office. She could have done her business by phone, but she was too irked to stay in her apartment. Besides, she was also annoyed at the field office people, and snarling at them in person gave more satisfaction than fuming by phone.

"Any word on that report yet?" she snapped without preamble as she walked in. The report on Bilbeis IV had gone in to Survey Service Central days ago, but none of the explosions Magda expected were happening yet.

"Let me check," the clerk sighed. He fiddled with his terminal, so slowly that Magda wanted to leap over the partition separating them and do it for him. He seemed oblivious to her impatience. After what could not possibly have been a year and a half, he looked up and said, "Central says the report never reached their files. Must be some computer trouble in the system somewhere."

"Oh, damnation," she said, loud enough to make people all over the office turn their heads her way. "Have you ever had trouble with the FTL link to that database before?"

"No," the clerk said. "Of course, there's always a first time. I think you'll have to resubmit." He sounded almost pleased at the prospect. Fieldwork attracted adventurers, while Survey Service offices drew routineers; the two groups often clashed.

Magda was not about to give this petty bureaucrat any more satisfaction than he'd already got. "All right," she said, so sweetly that he looked at her with sudden suspicion as she sank the barb: "Of course, at the same time I expect you'll submit a notice of trouble in the system. Give me your supervisor's name, so I can notify him or her that it's coming."

The clerk grumbled at the prospect of work he couldn't do on automatic pilot, but Magda had him dead to rights, and he knew it. He reluctantly coughed up his boss' name.

"Thank you very much," Magda purred. "I'll be back tomorrow with that floppy." She kicked herself for not having brought it with her, but she really had thought the glitch was at this end, not in the computer network. Still, she was not altogether displeased as she rode back to her place. Not only did she know now where the trouble lay, but she had also won the little duel with that officebound bungler hands down.

Her roommate was home when she opened the door. She and Marie Roux had been friends during fieldwork training half a dozen years ago and then, as was the way of such things, not seen each other since, though they had kept in touch with tapes. Finding each other on Topanga at the same time, they overrode the computer's temporary housing assignment to be together and talk about

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old times.

"Hi, Magda," Magda said.

"Hi, Marie," Marie said. They both laughed. They had been the only two redheads in their training group, and the instructors—and even some of the other recruits—mixed up their names so often they started doing it themselves.

"I wish I *were* Magda," Marie said. "My ship couldn't win an overhaul, let alone the travel pool. Carson Planet—mmmm! I'm jealous." She waved at the goodies Atanasio Pedroza had sent.

"Do you want to go?" Magda asked. "Be my guest."

"What? Don't be ridiculous, Magda. That trip is worth plenty, and besides, you'll have a good time."

"No I won't, because I wouldn't go if they paid me a bonus." Magda explained about Pedroza's unwelcome attentions, finishing, "So you see, Marie, that cabin will just be empty if you don't use it."

"You're serious, aren't you?" Marie said wonderingly. "I really would like to go, but—"

"But what? I told you already—go ahead, do it. You're not taking anything away from me, because I like Topanga without dear Atanasio about a hundred times better than Carson Planet—let alone the *Clark County*—with him."

"But—" Marie began again, but Magda knew she was wavering when she shifted her approach: "Even if I did try to go, that prize is for the crew of the *Jêng Ho*. What do I do when somebody asks me what I'm doing there?"

"So long as it's not Atanasio, tell 'em the truth. They all know about him and me. For that matter, you can tell him too. I have, often enough. He just doesn't listen."

"That's not what I meant. What do I do when they check my ID at the airlock?"

"Odds are they won't." Magda frowned, though, because they could, and she knew it. "Hmmm, tell you what—take my spare credit card."

"I couldn't do that!"

"Why not? We've known each other a long time now; you're not going to steal me blind. You'll need it anyway, to tap into the line of credit that goes with the trip. All your other expenses are paid; you shouldn't need to dip into my account. If it makes you feel better, you can leave your spare behind as a hostage."

"I'd insist on that at the very least. Damn it, I'm so tempted now, but it still won't work. When your credit card goes into the computer, the screen will display your picture."

"Hi, Magda," Magda said again.

"I don't think we look alike," Marie said.

"Well, I don't either, but most people certainly seem to. After all these centuries of stirring genes around, redheads are so uncommon that hardly anybody looks past our hair. You're going to gamble *on* Carson Planet, for heaven's sake; are you afraid to gamble a little to get there?"

Marie threw her hands in the air. "All right. I give up. Thank you!" She hugged Magda. "I still think you're crazy, but when do I leave? Do I have time to pack?"

"Here, give me that ticket. I didn't even look." Magda quickly checked it. "You're all right. You're not due out till tomorrow morning."

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"Plenty of time," Marie agreed. "One thing the Survey Service does teach you is how to live out of suitcases." She went over to the closet and with practiced efficiency started filling one. Her only hesitation came when she happened on something thin and filmy. She giggled and put it in.

Magda's back was turned. "What's funny?"

Marie displayed what she's packed. "I was just thinking I might end up liking this Atanasio what's-his-name better than you do."

"Maybe," Magda said. She let it go at that; Marie was her friend. What she was thinking was, better you than me.

Marie was up and ready well before she had to be. Magda carried one of her two suitcases down to the street for her. The shuttle route that Magda used to get to the Survey Service office went on to the spaceport. They rode together until Magda got off. She squeezed Marie's hand. "Have a wonderful time."

"I'm sure I will. Thank you again."

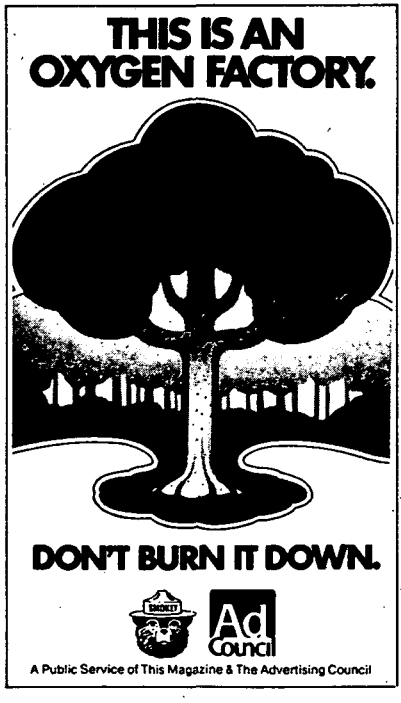
The shuttle pulled away from the curb. Marie waved through the window. Magda waved back, then walked down the street to the Service field office.

The clerk she had dealt with the day before looked up sourly from his tea as she came in. He grew even more unhappy when she walked around to his side of the desk. She took her floppy of the report on Bilbeis IV out of her holdall, handed it to him. "I just want to make sure you don't have any trouble copying the document to the database," she said innocently.

"I'm sure there will be no problem," he said. He looked as if he wanted to erase her disk but didn't quite dare. Instead, he put it in his terminal, punched two buttons, waited for a light to go from red to green, and handed it back to her. "It's in the system."

"Good. I hope that wasn't too difficult for you." Now the clerk looked as though he wished he had scrubbed the floppy. She tossed him a note handwritten on a memo form. "This outlines the foul-up and your part in it. Take it to your supervisor, and be careful with it till she gets it—it's the only copy."

The memo, she knew, would end up in the nearest trash can: that was the bone she threw the clerk for giving him a hard time. Getting the report on Bilbeis IV to the attention of the Survey Service—and the public beyond the



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Service—counted for more than making a functionary's life miserable, however much fun the latter was.

After that, as had happened after the first time the *Jêng Ho*'s crew sent in the report, she had nothing to do but sit around and wait for the roof to blow off Survey Service Central. Even if a new assignment came through, she wouldn't be able to do about anything it until the rest of the crew got back from Carson Planet.

If she had to vegetate, Topanga was a nice place to do it. The climate was warmer and drier than she cared for. The locals had adapted. They never hurried; they made a point of taking things easy, and viewed life with a relaxed detachment Magda envied without wanting to emulate.

She also did not care for the way they baked themselves under their sun. She preferred pale skin to bronze, and also preferred not to have to undergo skin cancer therapy every so often. The locals took the annoyance in stride, as they did everything else.

Thinking about the Topangans' indifference to malignancy brought Magda back inevitably to queen Sabium. Had David Ware not meddled with her fate, she would have been a millenium and a half dead, and Bilbeis IV like any other pretechnological world.

Having met Sabium, though, Magda could understand his interference, if not condone it. Sabium was—something else. With time on her hands, Magda began a monograph detailing the effect of her reign on her world. The work progressed only by fits and starts; Topanga's easygoing style proved infectious. Magda realized with a guilty start that a couple of weeks had gone by without her checking on what was happening with the report she had refiled. She went down to the field office to see what was up.

The clerk was friendlier than he had been the last time she came in. Amazing what giving him something to throw away could do, she thought. He didn't even seem unwilling to check on the status of the report on Bilbeis IV. "There shouldn't be anything wrong," he said reassuringly as he punched buttons. "Survey Service Central is a busy place, you know, and sometimes these things take a while to get a reaction."

"This one will get a reaction," Magda said.

The clerk's look said that she thought she and her little concerns were a lot more important in the grand scheme of things than they really were. Her answering glare told him he didn't know what the hell he was talking about.

The screen on his terminal lit. His brown face went smug as he glanced over to it—here he was, handing down The Word from on high, Magda thought scornfully. His smugness abruptly shattered. "What the—" he said, startled into a purely human reaction.

Magda walked around to see the screen for herself. He didn't scowl at her, the way he had before when she took such liberties. REPORT FROM SURVEY SERVICE SHIP *JÊNG HO*: NOT IN FILES, she read.

"That's crazy," she muttered. She turned on the clerk. "You must have screwed up the transmission again, uh, Pandit." (She had to read his name backwards through the clear plastic

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plate on his desk; she'd never bothered noticing what it was before.)

"I did not," he said angrily. "What are you doing, saying things like that? You hovered over me like some miserable vulture, and you didn't complain then."

"So I didn't," she admitted, taken aback by his hot response. "Well, what has gone wrong, then?"

"How should I know? Whatever it is, as far as Survey Service Central can tell, you and your whole crew are still in space. You'll have to retransmit one more time."

"Wonderful. The whole damn crew *is* in space, except for me. Captain Brusilov will nail my hide to the wall when he gets back, too. He'll have as much trouble believing back-to-back computer failures as I do."

"What else could it be?" said the clerk—Pandit, Magda reminded herself. She could not stay irritated at him; he sounded as puzzled as she was.

She said, "For all I know, the people at Central are scrubbing the damn thing on purpose every time it comes in." Pandit's expression said what he thought of that. Magda didn't believe it either. A little paranoia was all well and good, but letting it run wild was something else again. She sighed. "I suppose I'll have to bring it in again, won't I?"

"Unless you'd sooner save yourself the trip and just send me a copy through your computer."

"Not after all the trouble we've gone through already. I want to watch you again while you make the transmission to Survey Service Central."

"Whatever you say." It wasn't Pandit's problem.

"I'll see you tomorrow."

Magda went back to the apartment and made another halfhearted lunge at her monograph. Before long, she was looking for an excuse to quit. She turned on the news. She did not watch often; most of the time on Topanga it was comfortable chatter and not much else. Not this afternoon. A rubble-strewn crater filled the screen; disaster crews struggled frantically amidst the debris.

The newswoman was saying, "—almost certainly dead, of course, are the 316 passengers of the ill-fated starship. The toll is expected to rise far higher as the ruins of the crowded terminal building yield their grim secrets. Here is a list of deaths confirmed by credit card recovery—"

"Vultures," Magda muttered. She reached out to switch off the screen.

"—in the crash of the *Clark County*," the newswoman finished.

Magda's hand froze in the air. The rest of her also felt as if it had turned to ice.

Credit cards were nearly indestructible; men and women, sadly, not. Every so often, another name Magda knew would come up, setting her crying again. She and Irfan Kawar had been taken across the main continent of Bilbeis IV by animal-drawn coach to meet queen Sabium, the undying goddess; they had slept together through most of the journey. Norma Anderssen would never do any more linguistic work, nor would Captain Brusilov nail Magda's hide to the wall now. She even had tears for Atanasio Pedroza.

Then she saw her own name.

"But that's insane!" Magda yelled.

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She was tired of having people turn around to stare at her, and even more tired of being in positions where she made them turn around to stare. More quietly, she went on, "Here I am in front of you, Mr. Peters."

"Yes, Ms., umm—" The credit manager's voice trailed away. He'd done that before, as if he wouldn't have to admit Magda was alive if he didn't speak her name. Peters reminded her of Paulina Koch, though he and the Survey Service Chairman looked nothing alike. Both of them had the same air of being not quite human, but only projections of the organizations they represented.

"Mr. Peters, do I look dead?" she demanded.

"No," he admitted, not sounding pleased about it.

"Then why can't I make this stinking piece of plastic work? The red light goes on every time I try to use it. I've explained about how Marie was carrying my card when she went aboard the *Clark County*."

"So you have. Unfortunately, you have not explained why no card authorized to Marie Roux has been unearthed on Carson Planet. If that card appears, it will facilitate the substantiation of your account and the restoration of your credit. Until then, I lack the authority to make that restoration, as the cancellation of your account was not originally implemented here. All I can do is pass on the discrepancy notice to our headquarters and allow them to make the determination."

"Where *are* your headquarters?" Magda asked dangerously.

"Why, on the capital world, of course."

"You officious idiot!" Magda shouted. Everyone in the office who hadn't been looking at her before was now. She was past caring. "Here I am, and you can't even tell I'm not dead? Make any check you want on me, for heaven's sake. If the ID doesn't match what's on my card, put me away and throw out the stinking key."

"I was going to suggest that in any case. It will bolster your account in the report I submit."

That was as far as he would go. Gradually Magda realized he was not out to give her a hard time, but that he would not stick his neck out one millimeter for her either. "How long will your miserable report take to go through?"

"I can't be sure. A couple of weeks, perhaps, if the medical data are as you say. I'll hold off filing till I have them from you."

"A couple of weeks?" Magda echoed in dismay. "What am I supposed to do in the meantime, starve?"

She had meant it as a rhetorical question, but Peters took it literally. "If I might make a recommendation—"

"Please." By then Magda was ready to listen, seeing no way anything Peters said could make things worse.

"Well, then, I would suggest you use this Marie Roux's card, which is active, as your own while your credit identity is being reconfirmed. When that happens, or when her own death is established as fact, charges accrued can be transferred back to your account."

Magda knew he was trying to be helpful. She even knew he was giving her good advice. That didn't make it any easier to take. She had practically frog-marched Marie onto the *Clark County*

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in her place; if anyone but Pedroza had told her about the trip, she knew, she would have gone, and gone eagerly. But she hadn't, and Marie was dead instead of her. The thought of using her friend's card made her feel even worse than she did already—she hadn't felt like a ghoul before. And worse still, she knew she would do it. She left the credit office in a hurry.

The doctor who ran the medical checks on her that afternoon gave her a quizzical look. "You're paying me with *this* credit card so I can confirm you're the rightful user of *that* one?"

"Believe me," she told him, "it doesn't make any more sense to me than it does to you. Just rush those results over to Credit Superintendent Peters." She gave him the access code.

She went back to her apartment, and for the most part stayed there. She lived as frugally as she could, not wanting to use any more of Marie's credit than she had to. She watched the screen more in ten days than she had in the last couple of years, and in doing so discovered why she hadn't bothered. She did not watch the news.

Every morning she tried her own credit card. Every morning the system rejected it. She used the thesaurus program on her computer to generate page-long curses to call down on Peters's head.

The monograph got short shrift; Magda lacked the heart to work on it. She also kept delaying taking the report on Bilbeis IV back to the field office. Finally she made herself do it. She had no better monument to offer the crew of the *Jêng Ho*.

Riding the shuttle felt strange—she had grown too used to being cooped up. Pandit the clerk raised an eyebrow when she walked into the office. "You were so intent on transmitting this, and then you never came back. May I ask what happened?"

"I died," she told him, and took somber pleasure in watching his jaw drop. She added, "Ask your computer if you don't believe me."

His eyes widened as he made the connection. "The *Clark County*—"

"Exactly. I was supposed to be on it." Briefly, not naming names, she explained how she had stayed behind, and finished, "So if I had been on that ship, odds are this would have stayed shelved for good. Make sure Central gets it this time, will you, Pandit?"

"I don't know what went wrong the first two times." He sounded genuinely aggrieved; like Peters, he did not care for anything that upset his routine. Unlike the case of the credit representative, though, getting that routine back implied helping Magda, not frustrating her. He loaded the floppy into his terminal, squirted its data across the light-years.

"Come in, Roupen. Do please sit down." Paulina Koch flicked an imaginary speck of lint from her gray blouse. Her slacks were a darker shade of gray, almost charcoal; that was as much extravagance as she allowed herself as far as clothes went. Anyone who thought of the Survey Service Chairman in a negligee—in itself an unlikely notion—would have imagined her in a gray one.

"What's up, PK?" Roupen Hovannis rumbled. Paulina Koch handed him a

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printout. His always dour features grew harsher still as he scanned it. "We've already scrubbed this twice," he observed. "If we do it again, whoever keeps filing the damned thing will really start wondering what's going on."

"It's already gone," the Chairman said, "though I leave to you the details of making the erasure invisible. We've involved outselves too deeply in denying the authenticity of the report on Bilbeis IV to have it linger in public files even for a moment."

"That's true," Hovannis agreed. They both knew what an understatement it was.

Paulina Koch hesitated before going on, as if searching for words. At last she said, "After the tragic loss of the *Clark County*, I had not expected to see this document surface again."

"Neither had I," Hovannis answered. They said no more than that; the subject was much too touchy to go into deeply.

But they both knew one thing led to another. If asked, the crew of the *Jêng Ho* would have wrecked the official Survey Service assertion that the report on Bilbeis IV was a fraud. Then not only the interference but also its concealment would have come to light. Steps had to be taken, the Chairman thought, to protect the organization from unjustified criticism. No one from the *Jêng Ho* would answer questions from the Purists in the Assembly now.

That was fine. Nevertheless, Paulina Koch did not want to know any details. Hovannis, for his part, did not want her to know them; the fun and games with the situation on Hyperion had given her enough of a hold on him.

The Chairman said, "We have to be more thorough."

"I'll look into it," Hovannis said. By now, he had grown used to operating without specific orders. Had he been sitting in the Chairman's seat, he wouldn't have given them either. The less said, the less likely you were to perjure yourself later.

Paulina Koch was checking another printout. She nodded to herself. "As I thought: the entire complement of the *Jêng Ho* is listed as having been aboard the *Clark County*."

"I'll look into it," Hovannis repeated.

"Very well. Thank you for coming up." The Chairman's eyes had returned to her screen before Hovannis was out of her office. The item there had nothing to do with Bilbeis IV. After all, she had other things to do, too.

"Hello, Pandit," Magda said. "Let me guess—you've checked, and as far as Survey Service Central knows, you never sent in that report."

In the phone screen, the clerk's brown face grew even more troubled than it had been. "I am afraid that is correct. I tell you frankly, I have never seen another case like this. I don't know what to make of it. All the other documents I've processed have gone through flawlessly."

"It figures. Things have been going that way lately. As far as the credit system knows, I'm still dead, too. Something is screwed up in those computers, what's-his-name—Peters—says."

"I am sorry for your difficulties." Pandit actually sounded as though he meant it. Maybe he did, Magda thought;

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his orderly soul had to cringe from the chaos that had attached itself to her. He went on, "I suppose I can expect to see you again soon with your vanishing document?"

"No." Magda had decided to spread a little chaos herself. "I'm sick of this nonsense. I think I'm going to take the whole thing to the Noninterference Foundation and see what they make of it."

"You can't do that!" Pandit exclaimed in horror. Magda knew how he felt; giving information to the Noninterference Foundation was like going over to the enemy. The Foundation kept an eye on the way the Survey Service interacted with natives of pretechnological worlds. That would have been bad enough, but the private watchdog group got most of its support from the Purists, the people who thought the Service ought to keep off those worlds altogether.

Magda had about as much use for Purists as she did for cockroaches: to her they were two examples of pests the Federacy had never been able to eradicate. But that did not mean she thought the Survey Service ought to get away free when it made a mistake. Service personnel had interfered on Bilbeis IV, even if with the best of intentions, and the courses of billions of lives there had been changed as a result.

She said, "Going through channels hasn't done me any good. I've told you before, this report is important. One way or another, it has to get out."

"Yes, so you've said. All the same, do you feel like throwing away your own career in a fit of pique because of computer problems at Central? Think about the assignments you will draw when people know you collaborate with the Foundation."

Magda winced. What Pandit had suggested was illegal, of course. It was also very likely. For that matter, she wouldn't have wanted to ship with a known informer herself. "I've got good reason to go," she said, but her voice sounded defensive even to her.

"Yes, so you have said," Pandit repeated. "I'm sure you believe it, but remember, it is a step you cannot take back. May I suggest something to you?"

"Go ahead," Magda said grudgingly.

"Why not try once more to transmit your report through the proper channels? If you fail after four attempts, I do not suppose anyone could blame you for doing something irregular."

"As far as I'm concerned, they couldn't blame me after three." But despite her tough talk, Magda was secretly glad to have a chance to put off the trip to the Foundation. "Oh, all right. I'll see you before long. It had better go through this time, though; that's all I can say."

She broke the connection, picked up the floppy that carried the report on Bilbeis IV, and rode the elevator down to the lobby of the apartment complex. The nearest shuttle stop was only a short walk from the building.

A few minutes later, a slim, swarthy man somewhere close to her own age came out of the complex and joined her at the stop. His clothes were on the faded side; he wore a backpack. He looked tired. After a casual glance that told her that much, Magda ignored him, or tried to.

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He did not make it easy, though. He kept looking stealthily in her direction, and jerking his head away when she caught him at it. They were not the sort of glances a man gives a female stranger he finds attractive; Magda would have thought nothing much of those, one way or the other. It was almost, she thought, as if the fellow was wondering whether he knew her. With all the strange goings-on of late, she did not like that, because she was sure she had never set eyes on him before.

The shuttle came sighing up just as the man looked to have worked up the nerve to speak to her. With a feeling of relief, she fed Marie Roux's credit card into the slot by the door; she wanted nothing to do with him. Her leeriness only increased when she heard the fare apparatus suck up a bill—he had paid his way aboard with cash. People who used untraceable money generally had a reason for it, and rarely a good one.

From habit, Magda sat near the front of the shuttle. She was soon kicking herself for it. Once when she yawned and stretched, she caught the stranger staring at her from behind, though again he quickly looked away when he saw she had noticed him. After that she did not look back, but she imagined she felt his gaze on the back of her neck. It made for an unpleasant ride; she was glad to get off.

That did not last long. The stranger scrambled down as the shuttle was on the point of pulling away; its doors, which had started to close, hissed open for him. He had been holding his backpack in his lap, and paused to wrestle it on before leaving.

A trifle faster than she might have otherwise, Magda walked toward the Survey Service office, which fortunately was no more than a block and a half from the shuttle stop. She scowled—the stranger was still following her. If he tried anything cute, she told herself, she'd make him regret it. Like anyone who did Survey Service fieldwork, she had been trained in unarmed combat.

All of which, she thought, would do her no good at all if he had a projectile weapon. But if he planned on shooting her, he'd already had plenty of chances.

That reasoning was reassuring, but only until he came into the office after her. Then he made her feel like an idiot, because he headed straight for the director's room in the back. She supposed that having two people come from the same shuttle stop to the Survey Service office wasn't twisting coincidence's arm outrageously.

Pandit spotted her and saved whatever document he was working on. "My screen is clear," he declared. "We are ready for another try—a successful one this time, I hope."

"So do I," Magda said, taking the floppy from her holdall, "but I'm not going to hold my breath. Central doesn't seem to want to know about Bilbeis IV."

She had forgotten the fellow who had been in the shuttle with her. He stopped in his tracks, turned, and walked back toward her. "You really are Magda Kodaly, aren't you?" he said.

"What if I am?" she said, her suspicion of him flaring again.

"I thought you were, but I didn't dare believe it. I thought you were dead."

"You aren't the only one," she mut-

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tered. He stared at her, not understanding. "Never mind. What do you want?"

"That's the report on Bilbeis IV you have there, the one from the *Jêng Ho?*"

"Yes. Who are you, anyway? How do you know about it? I've been trying for weeks to get it into Survey Service Central files, and I haven't had any luck yet. This is my fourth try."

Pandit had loaded the floppy into his terminal and was about to hit the TRANSMIT button. "*Don't send it!*" the stranger exclaimed, so urgently that the clerk jerked his finger away in alarm. "Whatever you do, don't send it," the fellow repeated. He bent down, pushing Pandit aside, and took the disk from the computer.

"Give me that back," Pandit said indignantly.

"No." The stranger stepped away from the terminal. He still had a tight grip on the floppy. Magda tensed herself to grab it away from him. He noticed, and handed it to her. "Here—it's yours. All I ask is that you don't transmit it until you've heard me out. You're in danger if it goes to Central—you may be in danger anyhow."

"Do you know," Magda said to nobody in particular, "I've had more melodrama in my life in the little while since we came back from Bilbeis IV than in all the time before that, and I don't like it one bit."

"I believe you," the stranger said with perfect seriousness. "So have I."

Magda studied him. He neither looked nor sounded like a madman . . . and things *had* been strange lately. "All right, talk," she said. "This had better be good."

"None of it is good," he said; again he seemed very tired. "I don't want to talk here, in front of Survey Service people." Pandit let out an indignant sniff. The fellow said, "Nothing personal. Believe me, you're better off not knowing any of this."

"All right, we'll find a public terminal and see what you're so excited about," Magda decided. She pointed warningly at Pandit. "Don't go away. I may be back very soon." Then, turning back to the stranger, "Who are you, anyway?"

He waited until they were back on the sidewalk outside before he answered: "My name is Stavros Monemvasios. I am—I *was*—a grad student in anthropology at the University of Hyperion. My seminar group got assigned to summarize some newly arrived Survey Service reports."

Magda nodded; she'd had similar assignments herself, before she escaped to fieldwork. She and Monemvasios walked into a bank. The terminals were next to the pay phones. "You haven't really told me anything yet, you know," Magda said as she stepped into a booth. It was on the crowded side for two.

"Yes, I do know. I want to show you instead." Stavros looked the terminal over, laughed ruefully. "You'll have to pay for it, though. This thing doesn't have a cash slot, and I cashed out my credit card to get off Hyperion without making myself conspicuous."

"Hmmm." Magda gave him another hard look. She had already noticed he used cash, and wondered about it. Now he was practically admitting he'd done something shady on Hyperion. But she'd come this far—Clicking her tongue in exasperation, she shoved Marie Roux's

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credit card into the opening by the keyboard. The screen came on.

Stavros had been rummaging in his backpack. He pulled out a floppy, fed it into the machine, hit RECALL. The abstract of a document appeared.

"*Where did you get that?*" Magda was proud of herself. Instead of screaming the question, she let it out in a whispered hiss, but it was no less urgent for that.

"The report on Bilbeis IV, you mean? My prof gave it to me. I told you, it was my assignment. Go through it—make sure it's the same document the *Jêng Ho* submitted to Central."

Magda scrolled rapidly through the report, checking a page here, a page there. She was soon satisfied. "It's the same document." She was about to burst with questions, and felt like reaching over to shake the answers out of Monemvasios. "How did your prof get it? And why isn't he screaming his head off about it?"

"He got it because Survey Service records are—or are supposed to be—public documents. And he isn't screaming about it because he's dead." The flat statement brought Magda up short. Stavros also paused before he went on, and seemed to have to bring out his words by main force: "So is a woman who was in my class—she and I were trying to make people notice what this report means. We were also falling love with each other, but that's another story. And so is everybody who was on the *Clark County*. That includes the whole crew of the *Jêng Ho*, or I thought it did until I met you. Do I need to draw any more pictures for you?"

"You're saying the crash wasn't an accident." Magda's voice sounded faraway in her own ears.

"If it was, it was a mighty *convenient* accident for the Survey Service. Not even the Assembly can subpoena dead people, or ask them awkward questions about a report the Service calls a fraud from top to bottom."

"A what?" Magda clenched her fist until her nails bit into her palms. "The hell it is! We worked our tails off on that thing."

"I believe you," Stavros said soberly. "I daresay I know it better than anyone else who wasn't there, and it's a devastating piece of work—which only makes it more dangerous to the Service if it's true, because it shows just how serious the results of the interference on Bilbeis IV were. So they're denying everything—and with the *Jêng Ho*'s crew gone, who's to contradict them?"

Magda shook her head, but it was reflex fighting reason. What Monemvasios said made a horrid kind of sense. It certainly explained why she had not been able to get the report on Bilbeis IV into the files at Survey Service Central. She said so, adding, "No wonder they keep deleting it, if they can't admit it's real."

"No wonder at all," Stavros agreed. "Fogelman—my prof—must have accessed it just minutes after it came in the first time, before the Chairman decided she had to erase it."

"The Chairman?" Magda said, startled. She had never had much use for Paulina Koch, but there was a big difference between thinking her hidebound and the things Monemvasios was implying.

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"Haven't you seen any news?"

"No, not much," Magda admitted. "This isn't my planet, so I don't really care about what's happening locally, and the locals don't pay any more attention to what's going on offworld than they have to. Besides, the one time I did turn it on, the big story was the crash of the *Clark County*. After that, I just felt like finding a hole and pulling it in after me."

"I can understand that," Stavros said. He made a wry face. "For all I know, the story never even got here—the Federacy is a big place, with a lot going on. I liked to think we were making an enormous splash, but how could we tell for sure? We did get the Chairman to deny everything about Bilbeis IV in a news conference, though, and in front of an Assembly subcommittee. I suppose that counts for something."

"I should say so!" Paulina Koch shunned publicity. If she stood up in front of people to tell lies, Monemvasios really had hit a nerve, or rather, the report on Bilbeis IV had. And the Chairman never would have done it if she hadn't known the report had disappeared—Stavros was right about that, too. Magda said contritely, "I'll have to go back and recall the old news shows. Somebody here must have mentioned this mess at least once."

"Never mind that now," Stavros said. "Just tell me one thing: what was the FSY date when the *Jêng Ho* got back to Topanga and filed that report?"

"I'd have to check; I've got used to local time here. It's at the front of the document, though—we sent the report in as soon as we landed. Let me look." Magda moved the cursor to the beginning of the report. "That's what I thought I remembered. It was FSY 2687:139."

Stavros smacked fist into palm in triumph. "I thought so! We have them, then, on that too! When I checked on Hyperion, it was 157, and the Survey Service computer said the *Jêng Ho*'s report wasn't in yet—they'd erased it the first time, you see. But they still listed the scheduled arrival date of your ship as 139; the scheduling information must have gone on a different database from the report itself. That 139 disappeared not long afterwards, when they realized it was there, but—"

Magda followed him perfectly. "—We can beat them over the head with their missing eighteen days," she finished.

"Exactly!" For a moment, excitement lit Stavros's thin, worn features. He soon grew grim again. "Assuming we live to do it, of course. The way things have gone, that's not the best bet in the world."

"No," Magda agreed, shivering. "It's just accident that I wasn't on the *Clark County*." Even more quickly than she had with Pandit, she explained why she hadn't been.

Stavros nodded. "I have the feeling I got off Hyperion maybe one step ahead of the bastards who killed Fogelman and Andrea. I was the next logical target, even if the Hyperion police didn't try to hold me for Andrea's death. After everything else that's gone on, I was afraid the Survey Service had enough clout to make the constabulary think that way."

"I don't blame you," Magda said. "No wonder you've been using cash,

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come to that. Nobody can trace you that way."

"That's right. You're lucky yourself, even if it's a grisly kind of luck, having your roommate's credit card to use. You don't draw any attention to yourself with it. Even the coordinator at the local Service office thinks you're dead."

"Does she? She's an idiot, then. I've worked with her clerk since the *Clark County* crashed."

"She doesn't know about it. When I got to Topanga, I was just hoping to meet somebody who'd talked with the *Jêng Ho*'s crew, somebody who could help me show this report was genuine. The director gave me the address of what I gather is your apartment complex because several crewpeople had been staying there. 'Had been,' she said; she had no idea anybody was still there." Stavros stopped, looked alarmed. "Wait a minute. Have you tried to send in the report in Bilbeis IV since the *Clark County* went down? I thought I stopped you."

"You did, this time, but I'd already transmitted it once before that. I thought it was the last thing I could do for the *Jêng Ho*. What difference does it—" It was Magda's turn to break off abruptly. "You think they're going to come after me?"

"How can they afford not to? After everything they've done by now, they won't just lose their jobs if the truth comes out. They'll face rehab." Stavros and Magda both flinched at that. What went by the polite name of rehabilitation was usually reckoned worse than dying; it took longer and hurt worse.

"You're right, worse luck," Magda said. "Well, that tears it. Save your document there; I need to get a directory listing from the computer."

Stavros obeyed. "What are you going to do?"

"What I almost did earlier this morning: I'm going to take the whole miserable, stinking mess over to the Noninterference Foundation."

"Good!" Stavros exclaimed. "I wish Andrea and I had done that right from the start, instead of going to the newsnets ourselves. We need somebody on our side big enough to stand up to the Survey Service."

"Big enough to step on us, too, maybe," Magda said. "I don't like the Foundation very much. They can talk about being disinterested till they're blue in the face, but everybody knows the Purists bankroll them."

"Purists." Stavros's voice showed his distaste. No one who wanted to do fieldwork on pretechnological planets thought well of the Purists. If they had their way, they would get rid of the Survey Service altogether. A vocal minority of public opinion agreed with them.

"I know how you feel," Magda said. "I feel the same way, only more so, believe me. That's why I let Pandit talk me out of seeing the Foundation before. But the best shield I can think of against some damned assassin is publicity, and the Noninterference Foundation can give us that. They're good at it."

"And we don't have any better choices," Stavros said.

"That we don't." Magda stood up. "Let's go."

The local headquarters of the Noninterference Foundation was across town from the Survey Service office—not a

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good place for a watchdog, Magda thought sourly as she and Stavros took the long shuttle ride. She realized that was unfair; the real monitoring went on at Survey Service Central and outside the Federacy. She could not help being annoyed anyway.

To make things worse, the trip got interrupted when a horde of emergency vehicles, sirens screaming, tore across the shuttle's path. That did a splendid job of fouling up the traffic pattern.

Seeing Magda fidget, Stavros said, "The computer will fix things soon."

"Fat lot of good that does us now," she answered, but snapping at him did no more to relieve her concern than worrying about where the Foundation office was.

That office, when Magda and Stavros got there (at last, she thought), proved a good deal more luxurious than the one out of which the Survey Service operated. Looking around, Magda found herself with mixed feelings. A private organization needed to be affluent to take on a well-entrenched bureaucracy. On the other hand, these self-appointed advocates of poor, deprived peoples plainly had no experience of either poverty or deprivation themselves.

"What can I do for you people today?" asked a chunky, bronze-skinned woman who, coming our of her office, saw the two newcomers standing irresolutely just inside the door. Neither of them replied at once. The woman repeated, "Can I help you? I'm Teresa Calderon; I'm a senior analyst here."

"This is about the recent report on Bilbeis IV," Stavros began. "I don't know if you've heard about it—"

"Oh, yes, aside from the Foundation's own bulletins, it's been in the news here," Teresa Calderon replied at once.

Magda wanted to kick herself. She asked carefully, "What is the position of the Noninterference Foundation on Bilbeis IV?"

"I think frustration would probably be the best word for it. If the report the newsnets publicized is genuine, it shows a classic example of how drastic the effects of even well-meaning interference can be. But the Chairman has consistently denied the report's authenticity, and no one has been able to disprove what she says. After the *Clark County*, I don't expect anyone will. Speaking only for myself and not for the Foundation, it almost makes me believe some of the wilder claims that have been made in the affair."

"Believe them," Stavros said. Magda nodded.

Teresa Calderon's polite smile wavered. "Excuse me, but may I ask who you are?"

They told her.

The smile went out, to be replaced by incredulity. "One of you is dead, and the other one wanted for murder," Calderon blurted.

"I'm getting tired of being told I'm dead," Magda said. At the same time, Stavros was exclaiming, "What did I tell you?"

When some measure of calm finally returned, Magda produced her own credit card, saying, "I know I can't spend any money with this, but viewing it ought to convince you that I'm me." Teresa Caleron fed the card into a terminal. She looked from the picture on

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the screen to Magda, back again, slowly nodded.

Stavros said, "I'm too many light-years from Hyperion to prove anything, but I tell you that I was in a class when Andrea was killed. I don't know whether anyone went to the trouble of erasing that computer record, but people will remember, if somebody bothers to ask them instead of jumping to conclusions."

By then, Teresa Calderon was almost beside herself with excitement. "This is the opening we've been after for years! We can finally show how the Survey Service has been deceitfully concealing its blunders, and how its meddling has resulted in the exploitation of a whole planetful of innocent people for over a thousand years."

"That's not the word I'd use," Magda said sharply. She was reminded of why she mistrusted Noninterference Foundation people. The Federacy hadn't exploited Bilbeis IV; no one had been there at all between FSY 1186 and the visit of the *Jêng.Ho*. That didn't mean the long-ago interference had been right, but it had not been malicious.

The concealment afterwards, of course, was something else again.

Stavros broke her train of thought—and probably forestalled a good, snarling argument—by yawning enormously. "I'm sorry," he said. "I haven't done a whole lot of sleeping since I got to Topanga—actually, Magda, what I have been doing is looking for you, but I didn't know it. I told you about that before. Anyway, I don't have a place to stay."

"Come back to my building, then," Magda said. "It's cheap—"

"It had better be!"

"—and I know there are vacant rooms. Ms. Calderon, you don't need us any more today, do you?" Magda looked at her watch. "It's later than I thought. You can get things rolling without us, I'm sure. For better or worse, we're allies for a while, it seems."

"So we are." Teresa Calderon sounded very little more pleased at the prospect than Magda was. That did not keep her from diving for a phone even before Magda and Stavros had left the office.

"Exploitation," Stavros muttered as they boarded the crosstown shuttle. He made it into a swear word.

"You caught that too, did you? Good. You might as well get used to it. We're going to be the Purists' little darlings for a while. That's not what I had in mind when I joined the Survey Service."

"I don't suppose you had murder in mind, either," Stavros said, and to that Magda had to shake her head. They rode in uneasy silence for some time after that, and changed shuttles the same way.

"Wait a minute—we're not supposed to go down this street!" Magda exclaimed when the shuttle that usually went past her apartment complex took an unexpected turn.

Stavros pointed to the screen at the front of the passenger compartment. ROUTE CHANGED DUE TO TRAFFIC EMERGENCY AHEAD, it read. He and Magda looked at each other in alarm, both visualizing a Survey Service hijacking. The Service could probably foul up a shuttle route if it

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wanted to badly enough. No, scratch probably, Magda thought—the Service *could*.

She stabbed at the STOP AT NEXT CORNER button with her finger. Fearful sweat made it skid off the smooth plastic. She punched again, harder. Stavros was pressing the matching button on the arm of his seat. By the look in his eye, he didn't expect it to do any good either.

But the shuttle slid smoothly to a stop. The doors opened. Magda and Stavros scrambled down to the sidewalk with almost unseemly haste. They spun round, sure enemies would be lurking somewhere in the twilight. The shuttle disappeared down the street. Groundcars and lorries hissed by. No one paid the slightest attention to the two people on the corner.

Magda started to laugh and found she could not stop. Stavros finally had to hold her up. When the seizure was over at last, she stepped free of the arm he had round her shoulder. "Thanks," she said, wiping her eyes and rubbing at the pit of her stomach, which hurt. She told him, "If you ever had any doubts about whether I believed you, forget 'em. It's only taken me the afternoon to get as paranoid as you are."

"You're not paranoid when they're really after you," Stavros said grimly. "It's just as well you distracted me for a minute there; otherwise I expect I'd need a fresh pair of breeches." He did not sound as if he were joking.

"Let's get back to my complex," Magda said. She took a step and almost fell over; relief had left her unstrung. She caught Stavros's arm, and he straightened her again. He was stronger than his skinny build would have made her think. "Thanks. We're just a couple of blocks away. Come on."

As they rounded the next to last corner, Magda stopped in her tracks. This was the route the shuttle should have taken, and she could see why it had been diverted. Police and people in emergency gear were everywhere. Something fell with a rending crash. An ambulance screamed past.

"Here, you can't come any farther," a harried-looking policewoman said, holding up a hand to stop Magda and Stavros.

"But I live down this way," Magda protested.

"What address?"

"It's the apartments at 141 Surf."

The policewoman's face changed. "I'm sorry," she said, but she made no move to let them go. Instead, she pointed down a side street. "Emergency shelter arrangements are that way."

"Emergency—" Magda left the word hanging.

"Honey, you can count yourself lucky you weren't home this afternoon. That building blew up; a lot of people are still trapped. They'll arrange temporary housing for you down that way"—the policewoman pointed again—"and see that you have a bed and a hot meal tonight."

Magda still tried to press ahead. "Isn't there any chance I could salvage some of my stuff from the ruins?"

"Honey, if you lived at 141, you don't have much to salvage. Now just go on, will you?" And stop making me trouble, Magda read between the lines. The policewoman went on, not unkindly, "Survivors will have a chance

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to search for their effects after we make sure things are stable. You'll be informed, I promise."

"Thanks." Numbly, Magda went in the direction the policewoman had pointed out.

"You see," Stavros said, following.

"Oh yes, I see." Magda's tone was still flat, stunned. Somehow that made her sound more menacing, not less. "I'm not the only one who will, either."

But Stavros told her, "I said that too, and look how well I've done. Now you know what you're up against—they're playing for keeps."

"So am I."

"Thank you for coming here today," Paulina Koch said, looking out over the rostrum at the horde of video cameras. They peered back like so many long-nosed cyclopean beasts, and seemed more the masters than the servants of the people accompanying them. People and cameras alike were predators, she knew, and the blood they sought today was hers. The solid timber of the rostrum felt like a shield, holding them at bay.

"Chairman, do you have an opening statement?" called one of the reporters.

"No, I do not. I am here to respond to questions, and that is what I will do," Paulina Koch replied. She found no point to handing her foes free ammunition. Anything they wanted from her, they would have to earn. She pointed to one of the many upraised hands. "Yes, Mr. Karakoyunlu?"

The newsnet man was so surprised and excited at being called first that he forgot his carefully prepared question and blurted, "What about Bilbeis IV?"

Paulina Koch resisted (as many would not have) the temptation to reply, "Well, what about it?" Her answer was as painstaking as if the question had been a good one: "Bilbeis IV is a pretechnological world outside the Federacy. It was first visited by a Survey Service team in FSY 1186, at which time its civilization was early Bronze Age-equivalent."

"No!" Karakoyunlu was hopping up and down in frustration. "What about the *interference* on Bilbeis IV?" he shouted, hoping to make himself clear.

Again the Chairman chose to take him literally. "You are quite correct, of course. The anthropologist on that first expedition did interfere, contrary to all Survey Service policies and regulations, which even then were both clear and stringent. Upon his return to the Federacy, the individual in question could offer no defense for his actions and was quite deservedly cashiered." She chose another reporter. "Ms. Zedong?"

"What about the results of that anthropologist's interference on Bilbeis IV? Aren't they reflected in the recent report from the Survey Service ship *Jêng Ho*, and don't they show the interference caused a profound change in the planet's development, a change of exactly the sort the Survey Service is pledged to prevent?"

"Is that all one question?' Paulina Koch asked, raising some polite mirth. She grew serious at once, though, both because that was far more in her nature than frivolity and because she knew she could not seem to be evading the issue that had prompted the news conference. She said, "I presume, Ms. Zedong, you

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are referring to the report bearing the FSY date 2687:139."

"Of course, Chairman Koch. This is the report that first surfaced on Hyperion, and is now vouched for by the Noninterference Foundation and by the one surviving crewmember of the *Jêng Ho*—"

"I'm sorry to disappoint you, but the Survey Service's position on that report has not changed since it—what was the word you used?—surfaced (yes, that is apt). The person who brought it forward then is at the moment a fugitive from justice—a fugitive from a murder indictment, I might add. He hardly seems a trustworthy source."

"He denies it," three people said at once.

"Wouldn't you?" Paulina Koch retorted. She had strong doubts that this Monemvasios was guilty of anything —far more likely that was one of Roupen Hovannis's acquaintances—but she also knew she had told the precise truth: Monemvasios *had* run and he *was* charged.

"Well, what about" —Zedong looked down to check her reminder screen— "Magda Kodaly? She, after all, was present on Bilbeis IV, and is the source of much of the critical data in the report."

"Certainly Magda Kodaly was a crew member aboard the *Jêng Ho*. But please note that Magda Kodaly was reliably reported as having been killed in the tragic crash of the *Clark County*, and her credit card was recovered from the wreckage. Note also that the woman currently employing Kodaly's name has been using on Topanga the credit card of a certain Marie Roux. Nor did this alleged Kodaly respond to the recent subpoena sent to Topanga on behalf of the Assembly Subcommittee on Non-Federacy Contacts."

"Yes, but how much of an effort was made to serve that subpoena, Chairman Koch? After all, by then the *Clark County* had already gone down."

"So it had. As for what went into serving the subpoena, you would have to inquire at the Assembly. I am certainly not in a position to comment on the diligence of its employees." The small bit of sarcasm went down well; the newsnet people were avid for dirt on any segment of the Federacy government, not just the Survey Service. Paulina Koch resumed, "You do understand, however, that I am not yet in a position to acknowledge that the person claiming to be Magda Kodaly is in fact she. If anything, her association with Monemvasios would tend to make me think otherwise . . . Mr. Salaam?"

"Isn't it a fact, Chairman Koch, that Kodaly's association with the Noninterference Foundation is what prejudices you against her?"

"Certainly not," the Chairman answered evenly. "The Noninterference Foundation is a public-spirited body with the highest ideals, many of which I share. The Survey Service has nothing to hide or to fear." There was her first lie of the news conference, she thought.

Salaam's eyes twinkled as he asked his follow-up question. "Chairman Koch, isn't it a fact that you wouldn't believe it if the Noninterference Foundation told you the sun was shining?"

"I would look outside, Mr. Salaam." Paulina Koch had not intended the reply to be funny, and was taken aback by the

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laugh she got. She did not show it; she had schooled herself not to show anything. When the chuckles subsided, she nodded to another reporter. "Mr. Mir?"

"Hasn't Magda Kodaly taken steps to reestablish credit in her own name, and doesn't the physiological data she's submitted match those of the person who previously held credit under that name?"

"There you have the advantage of me, Mr. Mir. I would have to check on that." Again the Chairman spoke the truth, but not all of it. One of Hovannis's better computer people was still trying to change Magda Kodaly's credit system records. So far she had had no luck; the credit system's safeguards were the toughest in the Federacy. It was a losing battle, anyway. Sooner or later, Kodaly would be able to establish her bona fides.

Mir shrugged, but was not through. "There is also the matter of the eighteen missing days, Chairman Koch."

Paulina Koch's expression of polite interest did not change. "To what eighteen days are you referring, Mr. Mir?"

"You and the Survey Service have insisted the report on Bilbeis IV is not genuine. It is, however, dated 2687:139. On 2687:157, on Hyperion, your computer reported to Hyperion Newsnet that the *Jêng Ho* had not yet come back from its mission to make a report. When asked when the ship would return, though, it gave a date of 2687:139. You stated at the time that this was computer error, yet Magda Kodaly insists that 139 is in fact the correct date of the *Jêng Ho*'s return. Your comments?"

Only that it appears you're able to add two and two, the Chairman thought. She tried to picture what the newsnet man's face would look like if she said that out loud. Too late, if she intended to stay in the post she'd held so long—too late if she intended to stay free, for that matter.

She said, "I have seen nothing to make me change my mind, Mr. Mir, and you already know my reaction to the person claiming to be Magda Kodaly. It is remotely possible, however, I suppose, that an error has been made that is not accountable to computer malfunction. Accordingly, I have ordered Dr. Cornelia Toger, Survey Service Internal Affairs Director, to conduct a full investigation of any possible wrongdoing in this matter (which I stress I do not find likely), and to cooperate fully with any outside agencies conducting similar inquiries."

The newspeople sat up straighter—that was something they didn't know. They scribbled notes, muttered into recorders. Paulina Koch went on, "Dr. Toger will respond to your questions as to the nature of the inquiry now. I assure you that she is fully familiar with all aspects of the situation." She stepped away from the podium, beckoned Dr. Toger forward.

Dr. Toger did not know anything, did not suspect anything, and would not be allowed to find out anything. She fielded questions as best she could. She was earnest and sincere, but very much out of her depth.

Paulina Koch listened to her luckless aide flounder. She realized she herself had had no questions about the immortal queen Sabium. Down deep, she suspected, the reporters had trouble believing in a woman fifteen hundred years

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old, no matter what the report on Bilbeis IV said. She understood that. She had trouble believing it herself, and she knew only too well the report was real. Sabium would have been so much more . . . convenient as a legend.

When the conference was finally over, she went back to her office and asked Roupen Hovannis, "What do you think?"

He shrugged. "We're down, but we're not out. In a way, having the Noninterference Foundation weigh in against us does us a good turn. People know they hate us—it'll be easier to tar everything Kodaly says with their brush."

"Sensible plan," the Chairman said, nodding. "She's Survey Service herself, too, you know, even now. I wonder how much she cares for her new friends."

The talk-show host was suave without being oily, smooth without being facile. He had every hair perfectly in place. "Thank you for being with us, Ms. Kodaly," he said. "I'm sure you must be relieved to have formal use of your own name again."

"Yes, I certainly am, Mr. Vaughan." Magda's ears were full of the applause the audience had given her; she was still not used to being a celebrity. "Now that I've proven who I am, I can do a better job of proving just how accurate my colleagues' report on Bilbeis IV is."

"Of course," Vaughan nodded. "And of course you must agree with Dr. O'Brien that this kind of meddling on primitive planets can never be allowed to happen again."

Magda glanced toward the man sitting to the right of her on the couch. Peter O'Brien was the Foundation's head on Topanga, and fit the part: he was closing in on fifty, and looked more like a well-fed executive than an activist. He was directing the media campaign against the Survey Service; he had pulled the strings to get Magda into this studio.

She did not resent O'Brien for appearing with her. The Noninterference Foundation was backing Stavros and her to make political capital for itself; she understood that. But she had no more intention of turning into a Foundation puppet than she'd had of turning a blind eye to what the Survey Service had done on Bilbeis IV.

She said, "I do agree with Dr. O'Brien on that, Mr. Vaughn, but—"

"Call me Owen, please," the emcee broke in. "Sorry to interrupt. But what, Magda? Tell us, please."

"But I don't necessarily feel the remedies he proposes are the right ones," she finished.

Beside her, O'Brien shifted in annoyance. Vaughan's eyes lit up. Magda had no idea what his politics were, but a good argument would liven up his show. He said, "Why is that, Magda?"

"They're too drastic. The Survey Service monitors thousands of planets, almost every one of them with no trouble at all—in spite of what happened on Bilbeis IV (hell, partly *because* of what happened on Bilbeis IV back in FSY 1186). The Service takes the rule of noninterference very seriously. Disbanding it would be like cutting off your leg because you've got an ingrown toenail."

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"Dr. O'Brien, what do you think of—"

O'Brien did not need Vaughan to prompt him. "Magda's views reflect her training, naturally. I'd hoped the frantic concealment effort the Survey Service is making here would have opened her eyes to the cynicism inherent in all its policies."

"I don't see that," Magda said sharply. She was beginning to get angry; there was a difference between political capital and bullshit.

"Don't you?" O'Brien's voice had lost some of its detached tone too. He might look like a businessman, and even act like one most of the time, but underneath that veneer he was still passionately convinced of the righteousness of his cause. He growled, "I'm referring to the cynical pretense that Survey Service fieldwork has no influence on planets where it occurs."

"It doesn't, and you know it perfectly well," Magda said. "You're acting as if you don't know a damned thing about the training we go through—"

" 'We'?" O'Brien said icily. "I'm sure Paulina Koch would be pleased to hear you say that."

"Well, up yours, too." Whatever had been left of Magda's temper was charred ruins now. "She's wrong, but that doesn't make you right, you sanctimonious know-nothing son of a bitch."

Owen Vaughan sat back, steepled his fingers, and kept his mouth shut. His sponsors had been complaining that nothing really juicy had happened on his show since the night a couple of years ago when the actress got drunk and threw a glass of brandy in the mullah's face. They'd have nothing to grumble about tonight.

"Doesn't it?" O'Brien shot back. "Why do we have any right to meddle in the affairs of peoples whose only crime is being younger than we are? Let them develop their own way, I say, instead of corrupting them by our presence. I thought you would agree with me: you're the one who brought to the attention of the whole Federacy the sorry spectacle of millions of deluded people on Bilbeis IV following their false religion because of what the Survey Service did long ago."

"With queen Sabium as she is, they have a lot better reason for believing what they believe than most worshipers I know." But even Magda backed away from that one in a hurry—she needed to swing people to her way of thinking, not alienate them. "Besides, you're making it sound as if all the primitive planets the Service visits are more Bilbeis IVs—"

"They are, just waiting to happen."

"They are *not!*" Magda slammed her fist down on the arm of her couch. "For one thing, Survey Service procedures are different from what they used to be: we've already talked about that. For another, there just aren't that many Sabiums around, or key situations where interference really affects a world's development."

"Where's your evidence for that?"

"Where's yours?" Magda retorted. "If interference were as widespread a problem as you claim, we'd see cases like Bilbeis IV every other year. And we don't. We don't. Most of the time, the Survey Service does a good job. But when it doesn't, it has to be called to

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account. That's why I'm here tonight. That's supposed to be the purpose of the Noninterference Foundation too, as I recall, not wrecking the Service altogether."

"That is what we are for," O'Brien said, giving ground before her vehemence and also remembering she was valuable to him. "Where you and I differ is in judging how likely interference is. There's no doubt, though, that Bilbeis IV is a particularly flagrant case."

Magda nodded; she too was recalling that they had interests in common. "The worst of it, though, is the way Survey Service Central has done its best to sweep the report under the rug after the *Jêng Ho* submitted it. All my crewmates were dead, and so is the professor who first accessed it from public files . . . which it isn't in any more."

"There's such a thing as too much coincidence," O'Brien agreed. He did not say any more than that, not when he had no proof of anything but coincidence to link any deaths to Survey Service Central.

Owen Vaughan sighed imperceptibly. He had been hoping they would come to blows—*that* would have sent ratings through the roof on half the planets in the Federacy. But Vaughan was a practical man, who took what he could get and knew how to cut things short when the heat went out of them. "Let's take a short break for these words from our sponsors," he said, "and we'll be right back. . . . "

Magda pounded on Stavros's door. They were staying in side-by-side furnished apartments in a building owned by a prominent contributor to the Noninterference Foundation. Both apartments still kept the air of sterility that such places have when uninhabited: neither Stavros nor Magda had enough in the way of belongings to dissipate it. The explosion at 141 Surf had cost Magda hers, while Stavros left his behind when he fled Hyperion.

He took his time answering the door. Undoubtedly, Magda thought, he was checking the security camera first. She didn't blame him. She was cultivating the same habit herself.

"How did it go?" he asked, adding, "You still have your makeup on."

"Yes, I know. I haven't even been in my own place yet—I'm too disgusted to sit by myself. You're in this same miserable boat with me; if anybody would understand, you're the one." She threw herself into a chair. Except for being blue instead of green, it was identical to the one in her apartment, right down to the scratchy upholstery.

"That bad, was it?"

"Worse. Let me put it like this: if this O'Brien person had Paulina Koch's job, we'd be in the exact same mess we are now. Well, maybe not, on second thought—Koch can keep her mouth shut and deny everything with a straight face. That's not O'Brien's style. He likes to hear himself talk, so he gives away more than she would. The other delightful thing is that he's a damned Purist and hardly bothers to hide it."

"I got that feeling too, when I met him," Stavros said. "So much for the impartiality the Noninterference Foundation is supposed to show. Trouble is, we need him."

"I know, I know, I know. Otherwise I'd have loosened a few of his teeth for

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him. I still wish I had. He left a bad taste in my mouth."

Stavros got up. "Want to clean it out with a drink?"

"That's the first sensible idea I've heard since I got on camera." Magda held up a hand. "Wait a second, though—you don't like the sweet slop they drink here, do you?" Topangan taste in spirits ran heavily to liqueurs and creams, all of which Magda found cloying.

"Is vodka over ice all right?"

"Sure; that's fine."

Stavros went into the kitchen. Magda heard ice rattle in glasses. Stavros brought the drinks back. He handed Magda hers, shook a few drops from a small bottle into his. It turned milky. "What's that?" Magda asked, intrigued.

"Anise extract," he answered. "It turns the stuff into poor man's *ouzo*. Everybody drinks *ouzo* on New Thessaly."

"I know what you mean. We're the same way with plum brandy on Kadar, where I come from." She held out her glass. "Let me try some." He gave her drink the same treatment he had his. Knocking back a good-sized swallow, she felt her eyes water. She tried not to cough, and almost succeeded.

"Are you all right?" Stavros asked anxiously.

"Takes getting used to," she said. She drank again, more cautiously. "Not bad, I suppose, but it must be a lethal hangover mix."

"*Retsina*—resinated wine—is worse."

Magda's stomach lurched at the very idea. The things some allegedly civilized people drank—

She glanced over to the screen above the apartment terminal. She had noticed it was on when she came in, but had been too full of irritation to pay any attention to what Stavros was looking at. It was a sequence from the report on Bilbeis IV. She tried to recall whether it came from Irfan Kawar's ring camera or the one she had worn on the shattering day when they found the locals' undying goddess was in fact queen Sabium of Helmand.

Stavros followed Magda's eye. "I don't know how many times I've been through that part of the report," he said. "I keep trying to get a feel for what it must be like to have lived so long and to have been the focus of a whole planet's devotion for—how long?—fifty or sixty generations."

"I know what you mean. I've been trying to do the same thing myself, ever since I met her." Magda shivered, remembering the goddess' audience chamber and the later meeting in the guest chamber of the palace. "The other thing to keep in mind is that the tape can't convey more than a fraction of the presence she has. It really is as if she can see into your heart."

"I believe it," Stavros said. "There can't be much she hasn't seen, dealing with century after century of priests and courtiers and petitioners. There's nothing anywhere to compare her to: she's been the keystone of that planet's culture for almost as long as it's had civilization."

"There's more to it, though." Magda was glad for the chance to talk about Sabium. The flap over Central's

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suppression of the report on Bilbeis IV had pushed the queen herself into the background, even in Magda's own mind, and Sabium was too remarkable for that. Stavros made a good audience, too; he had studied the report enough to be as familiar with Bilbeis IV as anyone outside the *Jêng Ho*'s crew could be. As familiar as anyone alive, Magda realized, was another good way to put it.

But he had not stood before Sabium's throne, had never felt the crashing awe that came with meeting the queen who had become divine. Magda struggled to put that into words: "It's not only the length of life Sabium's had. Even more of it, I think, is the person she was before we tinkered with her immune responses."

Stavros frowned. "I'm not sure I understand."

"I'm not sure I do, either. But even back in her mortal days, Sabium was a good queen. She cared about her people, and about bettering the way they lived: her plan to reward inventions, for instance. The first Survey Service crew saw that—it's the main reason their anthropologist decided to cure her cancer. I suppose it's why he managed to talk the rest of them into it. And look at the mess he left behind."

"He didn't know—"

"No, he didn't." Magda cut off Stavros's beginning protest. "That's why you don't interfere—you don't know. I've sometimes shuddered, thinking how much worse things might have been if Sabium hadn't really been the able, kindly queen the first expedition thought she was."

"That hadn't occurred to me," Stavros said in a low voice. By his expression, he was going through the same set of appalling possibilities Magda had already imagined.

She said, "Here's something else to worry about: you're about the same age I am, aren't you—around thirty standard years?" She waited for him to nod, went on, "Did you ever have the feeling you're more distinctly *yourself* these days than you were, say, eight or ten years ago?"

Stavros nodded again. "Sure. The older I get, the more experience and knowledge I have to judge things by. My tastes are more settled, too: I like this kind of music and that kind of food. I expect I'll keep adding things as long as I live, but in the context of the structure I already have."

"That's exactly it—that's clearer than I ever thought it through, as a matter of fact," Magda said in surprised admiration. Because she was doing fieldwork while he was still a grad student, she automatically thought of herself as being more mature. His answer made her wonder. She continued more carefully, trying now to make each word count: "You and I have been growing into ourselves as adults for those eight or ten years. Sabium's been doing it more than a hundred times as long. As much as anything else, I think that's what makes her so intimidating—she's uniquely herself, uniquely an individual, in a way that no one who hasn't lived so long ever could be."

Stavros raised his glass in salute. It was nearly empty. "Well put," he said. "That's part of what I was looking for when I booted up the report tonight." He downed the rest of his drink, muttered something under his breath.

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"I'm sorry, I didn't hear that," Magda said.

Stavros's swarthiness could not quite hide his flush. He hesitated, plainly of two minds about repeating himself, then blurted, "I wonder what she's like in bed."

Magda burst out laughing. "Well, there's one I hadn't thought of." She looked at the screen again. Sabium appeared no different from the way she had at the time of the first Survey Service visit to Bilbeis IV, fifteen centuries before: a handsome woman in the first years of middle age. Her gray-pink skin, blue hair, and the light down that grew on her cheeks were only exotic details. They might even make her more attractive to a man, not less, Magda thought. "She'd be interesting, I expect," she said.

"Even with the chance, I don't know if I would," Stavros said, "or could, for that matter. I can't imagine anything more inhibiting than thinking of how much experience I'd be measured against." He shivered in mock fright at the very idea.

"Don't worry about it," Magda advised. "It's not as if it's something that's likely to come up."

"I thought I just said that."

Magda snorted. She held out her glass. "Fix me another one, will you? I'll pass on the anise this time, though."

She was not surprised to end up sharing Stavros's bed that night. Alcohol had little to do with it; that the two of them were trapped in the same precarious situation counted for much more. She and Irfan Kawar had slept together when Sabium's priests conveyed them across the main continent of Bilbeis IV to meet the undying goddess. It had brought comfort to them both, and did here again, until Magda thought of Kawar dying on the *Clark County* with the rest of the *Jêng Ho*'s crew.

She did not want to remind herself of that, not again, not tonight. She turned to Stavros, touched his shoulder. "I don't think Sabium would complain." She was not exaggerating much; her knees felt pleasantly loosened. He hardly seemed to notice the compliment, though. She wondered if she had pleased him. "What's wrong?" she asked.

He brought himself back to the here-and-now with a visible effort. Magda recalled she was not the only one with dark memories. "Sorry," Stavros said. "It's nothing to do with you, not really."

Any reassurance he'd meant to give collapsed with that two-word afterthought. He realized it at once, and made an annoyed noise deep in his throat. Magda lay beside him, waiting till he was ready to go on. After a little while, he did: "I'm sorry, Magda. It's just that this reminds me too much of the way Andrea and I ended up making love with each other not so long ago."

"Oh." It was Magda's turn to be silent and thoughtful. She finally said, "You told me once—I think it was the first time we met, after we came out of the Survey Service office—that you were falling in love with her."

"Yes, I think so." Stavros's eyes went first distant, then furious. He sat up, slammed his fist into the mattress so hard that he and Magda both bounced. "And not only did those bastards kill

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her, they landed the blame for it on me."

"You ought to talk with the Foundation people about that. There's bound to be a branch on Hyperion. Heaven knows I don't love them, but they have the money to dig out whatever they need to prove you were innocent—and once that's done, people are bound to start wondering just who did kill your Andrea, and why."

"You're right!" Stavros bounded out of bed. "Fogelman belonged to the Foundation. In fact, I think he was one of the higher-ups. And he was murdered too, and all his data banks scrubbed. What burglar would bother? Andrea and I tried to bring that up on Hyperion, but no one took it seriously—until the *Clark County* crashed, and then all it did was scare people. Now, though—" His lips drawn back in a predator grin, he started for the phone.

Magda coughed dryly. "Probably a good idea to put some clothes on first."

"Hmm? Oh!" Stavros clutched at himself.

"No need to hide from me, not now. Just pick up your pants." Watching while Stavros dressed, Magda saw she was forgotten for the moment. Now that he was reminded of his Andrea, she wondered whether he would have any more interest in her. If nothing else, life would be less lonely if he did.

She rolled onto the wet spot on the bed, swore, and then laughed. That was realism on the most basic level. Very few men, she thought, turned down the chance when it was there. That was realism, too. She got out of bed and went into the bathroom to clean up.

* * *

"It is always a privilege to meet with you, of course, Mr. Prime Minister," Paulina Koch said, smoothing an imaginary wrinkle on the sleeve of her gray smock, "but may I ask the reason for which you invited me to Government Mansion?"

Amadeo Croce matched her formality. "It is this Bilbeis IV matter, Madam Chairman." He tried to sound stern, and did not succeed well. Administrations came and went, but senior bureaucrats held the real, the lasting power in the Federacy. He and Paulina Koch both knew it.

"In what connection, sir?" the Chairman asked, deferential as protocol required. She would not flout his nominal authority, not now, not when the Survey Service needed every scrap of political help it could get.

Croce frowned a little. The expression did odd things to the lines on his face, which years of smiling at cameras had set in a mold of permanent affability. He said, "I feel the Service is, uh, unduly dilatory in dealing with the accusations of mishandling that have so persistently wrapped themselves around the situation relating to that planet."

"To which accusations are you referring?" Paulina Koch asked coolly. "The ones that allege Survey Service personnel guilty of everything from sabotage to murder to who knows what else? If you believe those, sir, I can only wonder why you called me here and not to the Office of Rehabilitation."

"No, no, of course not," Croce said, to Paulina Koch's well-hidden relief. One power the Prime Minister did have was control over the constabulary. It was a more brutal sort of power than

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the clashes of influence that formed the usual government shakeups, but it was there. The Chairman had never had to fear it before. Now she did. She was the only one who knew it, but it still weakened her.

Her musings made her miss the Prime Minister's next sentence, which was also unlike her. "I beg your pardon, sir?" She had no great regard for Croce, but the apology was genuine; she did not like to slip.

"I was just saying that, as far as I can see, no convincing evidence for anything past happenstance has surfaced concerning those charges. But the ones touching on Survey Service Central's handling of the report on Bilbeis IV itself do concern me."

"Given the nature of the people making those charges, sir, I must confess to wondering why. The Noninterference Foundation has been sniping at the Survey Service for several hundred years now—"

"I wasn't referring to the Foundation," Croce interrupted. "I meant the principals themselves, this Monemvasios person and the anthropologist off the *Jêng Ho* itself. If they are to be believed, Bilbeis IV has encountered interference in its development caused by Survey Service personnel, and the report documenting that interference is genuine. And I have to tell you, the more they talk, the more credible they sound."

"It does appear that the person who claims to be Magda Kodaly may in fact be she," Pauline Koch admitted grudgingly. "As for the other one, though—"

The Prime Minister broke in again. "I know what you are going to say. I have information, however, that the authorities on Hyperion are dropping all charges against him: he definitely was in a classroom when his girlfriend's murder took place."

"Really?" Paulina Koch's eyebrows arched in surprise, but she had known that bit of news for a day and a half. Croce's interrupting her twice in a row worried her more. Attuned as she was to the nuances of bureaucratic maneuvering, she read there the warning that he no longer felt as much need to conciliate her as he once had.

"Yes, it is true. And if this Monemvasios individual is to be believed, and if the woman Magda Kodaly was in fact aboard the *Jêng Ho*, I hope you will not be offended by my repeating that their view of the report on Bilbeis IV is also enhanced."

"Sir, I take no offense, but I respectfully have to disagree with you," the Chairman said.

Croce raised an eyebrow. "You must tell me why."

"Even if Kodaly was in fact on Bilbeis IV, that says nothing about the accuracy of the document submitted as a report on the mission of the *Jêng Ho*. Kodaly was, if you recall, one of the two main actors in the wilder claims that document makes, and the interpretation of events going into those claims is almost exclusively hers. To put it as mildly as possible, her objectivity is suspect. If she were well-disposed to the Service, would she be associating with the Noninterference Foundation?"

"An interesting question," the Prime Minister said. Paulina Koch studied him with sudden sharp attention, thinking she scented irony, but his politician's

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face was proof against her scrutiny. He continued, "A pity we lack the remaining members of the *Jêng Ho*'s crew to give her the lie, is it not?"

"A great pity, and a great tragedy." Paulina Koch reminded herself that she still did not *know* exactly what had happened to the *Clark County*. She did not remind herself that she had not tried to find out. Ignorance felt more comfortable, to say nothing of safer.

"That being the case, however, I suppose you are going to accede to the Noninterference Foundation's request that they conduct a new investigation of the situation on Bilbeis IV, to ascertain precisely what that situation is."

Only the Chairman's wariness and experience let her evade the trap. She was sure her meeting with Croce was being recorded; a panicky shout of "No!" could be plenty to sink her, while a yes was even more unthinkable. Her voice came out steady as she replied, "I have several reasons for believing that to be inadvisable." Down deep where it did not show, she was proud of her sang-froid.

"Let me hear them." If the Prime Minister felt disappointment, he was also a dab hand at not showing it.

Many sessions of testifying before the Assembly without notes had given Paulina Koch the knack of quickly organizing her thoughts. "First, of course, is the question of impartiality. The Noninterference Foundation's ties to the Purists are notorious, and have been only too evident throughout the present affair."

"That statement is self-serving, you realize."

"Yes." Paulina Koch was always ready to yield a small point to gain a large one. "That does not make it any less true."

Croce chuckled. "Well, maybe so. Go on."

"Thank you, sir. I also must remind you that for the Noninterference Foundation to undertake such a mission is in itself a contradiction in terms. Are the Foundation's people so steeped in moral purity that they can avoid causing the very kind of interference they claim to reject?"

"Were you to ask them, I am certain they would tell you so," the Prime Minister said. He had been in his profession far too long to have escaped cynicism.

"Yes, no doubt," Paulina Koch agreed as sardonically. "I was, however, asking you. I would also ask you to consider that, while they spend so much of their time complaining about what we do, they lack the training for survey missions of the type we do routinely, let alone for one as delicate as this."

"I begin to see your drift."

Croce did not sound happy with it. Paulina Koch played her trump card: "Finally, think about whether you would be happy at the precedent set for a private organization usurping here the function of a government bureau. Are you willing to have that happen whenever a publicity campaign whips people into a frenzy, deserved or not?"

The Prime Minister stiffened. That, thought the Chairman with the first real optimism she had felt during the meeting, hit him where he lived. No official, elected or appointed, could warm to the notion of having authority taken out of

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his hands. "What do you suggest, then?" Croce asked.

"I suppose that in light of the hue and cry over Bilbeis IV, regular procedures must be set aside." The distaste in Paulina Koch's voice was twofold. Setting aside regular procedure was unpleasant to her in and of itself. And when doing so also involved having to retreat to a fallback position, that only made things worse. She did her best to maintain a bold front: "Any new survey team that visits the planet will have to be extraordinarily discreet. Survey Service personnel are the only logical choice for the mission."

She already had most of the crewmembers in mind—loyal, pliable souls one and all, people who would see only what did the Service the most good. Fallback positions were stronger when prepared in advance.

"I had thought you might say that." Amadeo Croce took a deep breath. "I must tell you that in view of this administration, what you have suggested is not adequate. I shall so state on the floor of the Assembly. I would sooner have the Noninterference Foundation conduct the inquiry. The Survey Service is too deeply compromised to be the sole arbiter of its own affairs."

Behind her unrevealing features, Paulina Koch's mind raced. This was what Croce had summoned her here to tell her. Normally, the administration backed its bureau chiefs to the hilt; they were the ones who carried out the policies the politicians set. And Croce was no Purist, nor were the members of his cabinet. He had no strong ideological commitment to going after the Survey Service. He had simply scented weakness, and decided to get clear of it.

Tasting gall, the Chairman asked, "What plan do you have in mind, then, sir?"

"I shall propose a solution that would make Solomon proud," the Prime Minister answered. Seeing that the allusion meant nothing to Paulina Koch, he explained, "You are right in one way, Madam Chairman—we have to send a new mission to Bilbeis IV. I think you also make good sense when you advise against putting the expedition in the hands of the Noninterference Foundation. One of your people will retain overall command. But I will urge that the mission be made up half of Service personnel, half of individuals chosen by an independent agency, and for that role the Foundation seems the obvious choice."

The solution struck the Chairman as contrived; whoever this Solomon had been, he hadn't had much upstairs. On the other hand . . . she nodded slowly. A divided expedition could be counted on to produce an ambiguous report. At the moment, she—and the Survey Service—could hope for nothing better. A couple of other possibilities also occurred to her.

"Very well, sir," she said.

The Prime Minister had opened his mouth to argue her down. He shut it again in glad surprise.

"They're not going to get away with that!" Stavros exclaimed, staring at the formal hardcopy message he had just opened.

Magda read it over his shoulder. "You bet your life they're not." Her

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voice was full of the same furious disbelief that filled his.

Stavros took her cliché literally. "Yes, I have, and so have you. Is this the gratitude we get for it?" He read in a singsong voice: " 'Thank you for your interest in participating in the renewed investigation of the planet Bilbeis IV. Unfortunately, these positions require more experienced individuals.' "

"There are no people more experienced with Bilbeis IV than the two of us," Magda said: "me directly—hell, now I'm the only person in the Federacy who's ever been there—and you because you're been through our report until you probably know it better than I do. And so—" She took her anger out on the phone buttons.

A well-scrubbed young man's face appeared on the screen. "Noninterference Foundation."

"We're Kodaly and Monemvasios. Put us through to Dr. O'Brien right now. If he doesn't feel like talking to us—and he probably won't—tell him his other choice is listening to us on the newsnets later, and that he'll like that even less."

"Remind me not to let you get angry at me," Stavros whispered when the screen went momentarily black. "I think I'd sooner just stand in front of a shuttle and get everything over with at once."

Magda managed a grim chuckle. "I'll take that for a compliment. You know what we're going to hit him with?"

"A hammer, by choice," Stavros growled. His temper was not as quick as Magda's, but she had already found he was impossible to move from a position once he dug in his heels. He squeezed her hand, saying, "I think so. I'm with you all the way. I—"

He broke off abruptly, because Peter O'Brien's image replaced that of the Foundation underling. O'Brien eyed Magda with a singular lack of warmth. "What's this all about?" he demanded.

"I think you know," Magda said. She smiled a little when Stavros wordlessly held up the form letter; sure enough, he knew what she was up to.

"I am sorry." O'Brien did not sound sorry. "You must understand that we have to involve only the most qualified people on a project of the importance of this one. There is nothing personal involved."

"For one thing, I don't believe you. For another, where will you find anybody else who's met queen Sabium, the undying goddess a whole planet worships? For a third, where would you be without Stavros and me? You owe us slots and you will pay off, or I'm sure the newsnet people—and the whole Federacy—will be fascinated to hear how the high and mighty Noninterference Foundation shoved us to one side the minute we weren't useful to you any more."

"Do you think you can blackmail me?" O'Brien rumbled.

"Damn right I do," Magda said gleefully. "Fix it and fix it now, or we'll have other calls to make. Remember, the more you look like Purists, the less reason people will have to believe your side of the story. And kicking us off your crew will make you look an awful lot like a Purist to an awful lot of people. Me, I'm one of 'em."

"I'm another," Stavros added.

"Now," Magda said with a sweet

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smile, "shall we ring off and start getting hold of the newsnets?"

"I can't permit that," O'Brien said. "It would be—"

"Can't?" Stavros broke in. "Can't? How do you propose stopping us? The same way the Survey Service stopped professor Fogelman and Andrea and the *Jêng Ho*'s crew? Do we ask for protection from you next?"

"No, of course not:" O'Brien made a pushing-away gesture, as if to put distance between himself and Stavros's suggestion. For the first time, he seemed flustered. "We would never do, never think of such a thing. Of course you are free to do as you wish. It would hurt your cause as well as ours, though. Please think of that, please don't do anything you might come to regret—"

"You know what we want," Magda said implacably.

"Let me get back to you," O'Brien pleaded. "This is too big a decision for me to make on my own."

"We'll wait until tonight, no longer," Stavros told him.

"Tonight?" Now O'Brien looked horrified. "That's much too soon. Some of the people with whom I have to consult are offplanet, and—"

"Tonight." Stavros switched off the phone in the middle of O'Brien's protest. When it chimed again, a moment later, he hit the REFUSE button. The noise cut off. He grinned a small-boy grin at Magda.

She hugged him. "You couldn't have backed me better! Nothing makes the Foundation angrier than being compared to the Service."

"I meant it." Stavros was still serious. "The minute any power group sees an edge, it grabs, and anybody in the way had better look out. And we aren't the kind of friends Purists feel comfortable with. That show you did with O'Brien must have made him sure of that."

"I don't want any Purists feeling comfortable with me," Magda snorted. "All they want to do is set every social science there is back a couple of thousand years. And speaking of setting back, you just cost the Foundation a nice tidy sum there."

"Yes, I know. If O'Brien does have to confer offworld—and he probably does—he'll need to use the FTL links, and those aren't cheap. But I figured that setting a deadline he'll have to scramble to meet would show him we weren't fooling."

"Smart." Magda was still discovering just how good an ally Stavros made. He was unprepossessing, especially at the moment—he was regrowing the beard he'd shaved off when he escaped from Hyperion. Unlike her, he was given to hesitating before taking something on. But once he committed himself, he did not back away, and the rein he held on his temper let him keep getting in telling shots after she was reduced to outraged incoherence.

His single-mindedness could also be irritating. Once O'Brien was no longer an immediate concern, he went back to what he had been doing when the Foundation's letter arrived: poring over the report on Bilbeis IV. Magda draped herself against his back. "Shall we kill some time until they call us again?"

Without looking away from the screen, Stavros said, "Let's wait until we know whether we have anything to cele-

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brate." She angrily strode away, and had very little to say to him the rest of the afternoon. She would have got more satisfaction from her silence had he noticed it.

But they both dashed for the phone when O'Brien called back not long before sunset. "You win," he growled, and switched off himself.

"Probably making sure you didn't beat him to the—" Magda began.

Stavros found a very effective way to interrupt her. She never did finish the sentence. Sometimes, she thought a good deal later, single-mindedness was an advantage.

Survey Service crews normally departed with no more fanfare than anyone else going off to do a job. The takeoff of the *Hanno* was different. It drew Assemblymen, Noninterference Foundation bigwigs, the Chairman of the Survey Service, and enough newsnet people to fill a luxury liner past takeoff weight.

Magda preferred the usual way. Everybody wanted to make a speech, and everybody's speech was running long. The only thing she was grateful for was that the crew got to sit down. A camerawoman, on her feet for hours, had already passed out.

A black Assemblyman named Valleix was just finishing putting five minutes' worth of idea into a twenty-minute speech. Listening with one ear, Magda gathered that he was against the Survey Service and everything it stood for; he did not seem clear on what that was. The Foundation honchos up on the platform with him applauded lustily. Gritting her teeth at having to work with such people, Magda only wished he would shut up and go away.

Stavros might have been reading her mind. He leaned over and whispered, "I'd sooner be meeting interesting people instead of going through all this nonsense."

"Me too." The crew of the *Hanno*, especially the contingent the Noninterference Foundation had chosen, was a high-powered group. Magda knew several members' work. She chuckled under her breath. Without arm-twisting, she and Stavros weren't nearly well enough established to be here at all.

Paulina Koch was coming to the podium. Magda's feelings about the Chairman were still mixed; it was hard to think of her longtime boss, the head of the organization in which she had wanted to spend her whole career, as the enemy. At least, Magda thought, Paulina Koch was not longwinded. She would say what she had to say and then quit.

"A subtracter is also nice and straightforward," Stavros said when Magda told him that. "All it does is kill you."

"What's a subtracter?"

"A big poisonous worm-type creature we have at home."

"We have something like that on Kadar too. We call the thing an adder, after the Terran snake."

"I suppose one of our early settlers decided that didn't make much sense," Stavros said, "considering what it does. Greeks are very logical people." He grinned. "We also love to play with words."

The byplay had made Magda miss Paulina Koch's opening remarks. The Chairman was saying, "It is our hope

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that this mission will succeed in bringing back an unbiased account of conditions on Bilbeis IV, so that we can if necessary evolve new techniques for making contact with pretechnological cultures even more effective yet discreet than is the case at this point in time."

" 'If necessary'!" Stavros snarled. He was no friend of the Chairman's, and never would be.

"In all candor, we initially doubted the necessity for a new visit to Bilbeis IV," Paulina Koch continued, "but we are now convinced that valuable data may be gleaned from it. It will also serve as a model of cooperation between our agency and organizations which hitherto have not always been in accord with us. From it we may learn to go forward in harmony."

"And I may learn to go into stardrive without a ship," Magda muttered. She had been in the Survey Service too long to believe the Service and the Noninterference Foundation were ever going to get along. She did not believe Paulina Koch thought so, either. The hypocrisy in the speech made her grimace; it reminded her all too much of the political games she had had to play herself lately.

Paulina Koch stepped down. Somebody else stepped up. More rhetoric spewed out for the cameras. Magda endured it, dose after dose. Finally it was done.

"At last, the point of the exercise," Stavros said as the crew of the *Hanno* followed their commander to the ship. As was customary, the commander paused at the top of the boarding ramp to greet the people with whom he would be traveling.

He was a dark, broad-shouldered man who looked more like an engine tech or a stevedore than any sort of leader. That was Magda's first impression of him, at any rate. She changed her mind when she saw his eyes, which were shrewd and opaque. He wore Survey Service coveralls.

"Captain Hovannis," she said, holding out her hand.

He did not take it. "Ms. Kodaly," he said. His voice was deep and rough. He did not shake Stavros's hand either, and ignored the glare he got.

Stavros was still fuming as he got ready for liftoff. "Cold-blooded bastard," he complained over the intercom.

"Screw him," Magda said. "He's Service, and he doesn't have any reason to like us. The angrier we let him make us, the happier he'll be. If I do get angry at him, I want it to be for my reasons, not his. Make sense?"

"Yes," Stavros said reluctantly.

"Relax, then. We're on our way."

"We are?"

Magda waved at her outside viewscreen. It showed the black of space.

Stavros laughed at himself. "I keep missing takeoffs."

"You're here, and that's what counts."

"No," he said. "What counts is when we get there."

Magda thought about it. "You're right." ■

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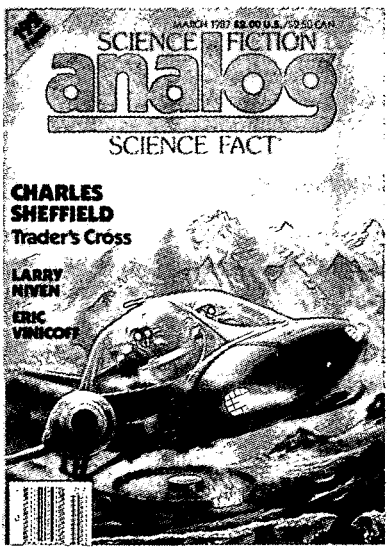

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on gaming

Matthew J. Costello

Not too long ago, I had the opportunity to play *Photon* in a nearby franchise. (*Photon*, of course, hopes to turn into the McDonald's of licensed intergallactic war games.) In a bid to become the bowling of the future, *Photon* offers stereo sound, laser lights, and heavy-duty light-sensitive combat gear for teams to carry out their own version of *Star Wars*.

And if you dutifully read my report in last October's "On Gaming" column, you know my somewhat mixed reaction to the experience. I just couldn't see people playing *Photon*, in leagues, or teams, or whatever, the same way they golf or bowl. Now, *Photon* had invaded the toy stores. Along with *Laser Tag*, a similar game, it hopes that its sophisticated battle gear will find their way onto the heads and hands of kids of all ages.

And I don't doubt they will.

First of all, let me compare the two competing game systems. (And pay attention here. Even if you don't have kids, you may want this stuff.) A basic *Laser Tag* set (World of Wonder, 4209 Technology Drive, Fremont, CA 94538; $39.95) comes with a Star Lyte (a space gun), a Star Sensor (a device you wear on your chest that tells whether you've been tagged), and a Star Belt. *Laser Tag* describes it as a game of space-age tag. But you and I know better. Put that set on and its Flash Gordon versus Ming's Monguls.

The Star Lyte has a range of 100 feet, and it can be adjusted for wide or narrow beams, depending upon the difficulty desired. Optional items include a Star Helmet ($39.95) and a Star Cap ($19.95), either of which I guess you wear on your Star Head. They both have LEDs to signal hits, oops, I mean tags from the Star Lyte.

The basic *Photon* set comes with a helmet, sensor, and phaser (Entertech, a Division of LJN Toys Ltd., 200 Fifth Avenue, Suite 734, New York, NY 10010; about $69.00). While the *Photon* phaser only has a range of about 40 feet, it has a number of features not found in *Laser Tag*. First, the phaser signals and keeps track of the number of times you're hit. While your *Laser Tag* chest sensor does this also, it's a bit awkward to crane your neck around to get a look at your chest. (Go ahead, try it.) The *Photon* helmet has lights that blink on and off, and a light sensor to detect hits.

Winner of the two-game derby is, from my perspective, *Photon*. While it doesn't have the range of *Laser Tag*, its helmet and chest devices are solid items, while *Laser Tag*'s Star Sensor is, at best, precariously held onto the provided chest strap. *Laser Tag*'s Star Lyte, while a well made item, looks a lot less durable than the chunky *Photon* phaser. And *Laser Tag* lacks the "connectedness" of *Photon*. In *Photon*, hits are

(continued on page 185)

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THE ANALYTICAL LABORATORY

Thanks again to all of you who voted in our annual poll on the previous year's issues of *Analog*, and congratulations to the authors and artists whose work you picked. And now, the envelopes, please ...

As you probably remember, we asked you to look over all our issues dated 1986 and list, in order, your favorite and almost-favorite items in each of these categories: novellas and novelettes, short stories, fact articles, and covers. (Sometimes we also ask you to vote on serials, but in 1986 we only had two.) This kind of feedback is very important to us—and to you, because it affects what we look for to publish in the future. So the more of you who vote, the better for everybody. (Please remember that for next year!)

To calculate the results listed below, every first-place vote for an item counted as three points, second place two points, and third place one. The total number of points for each item was divided by the maximum it *could* have received (if everyone had ranked it #1), and that result multiplied by 10 to give the score listed here. In principle, scores can range from 10 (spectacular) to 0 (not spectacular). In practice, scores tend to run lower in categories with many entries than in those with few. For comparison, I've included in

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parentheses at the head of each category the score each item would have received had all been equally popular.

NOVELLAS AND NOVELETTES (0.63)

1. "Eifelheim," Michael F. Flynn (3.86)
2. "The Mick of Time," Spider Robinson (1.50)
3. "The Evidence of Things Not Seen," Timothy Zahn (1.30)
4. "The Picture by Dora Gray," Charles L. Harness (1.11)
5. "The Big Dish," John Berryman (1.06)

SHORT STORIES (0.57)

1. "Phreak Encounter," Roger MacBride Allen (1.63)
2. "Brain in a Pocket," Rob Chilson (1.49)
3. "Godkiller," P. M. Fergusson (1.22)
4. "Relics," J. O. Jeppson (1.15)
5. "To Fit the Crime," Joseph H. Delaney (1.10)

FACT ARTICLES (1.54)

1. "The Longe Stern Chase: A Speculative Exercise," Rick Cook (3.78)
2. "The Curious Case of the Humanoid Face—on Mars," Richard C. Hoagland (2.94)
3. "A Little More Pollution, Please!" George W. Harper (2.46)
4. "Making *Star Trek* Real," James R. Powell and Charles Pellegrino (1.59)
5. "Fermi Paradox—The Final Solution?" Duncan Lunan (1.27)

COVERS (1.54)

1. May: Tom Kidd, for *Marooned in Real Time* (5.47)
2. November: Pat Rawlings, for "The Big Dish" (3.02)
3. July: Vincent di Fate, for "Red Wolf" (2.61)
4. February: Vincent di Fate, for "Survivor Guilt" (1.65)
5. June: Doug Beekman, for "The Evidence of Things Not Seen" (1.44)

Michael F. Flynn's "Eifelheim" made an especially strong showing: it's rare for a story to stand out so far from the competition. At first glance the fact articles seem to suggest that you like long titles with unusual punctuation, but at a more serious level they also confirm that you like a good healthy dose of speculation with your fact. At least two of those articles generated unusual amounts of heated controversy—but when it comes time to vote, that's what *Analog* readers often prefer!

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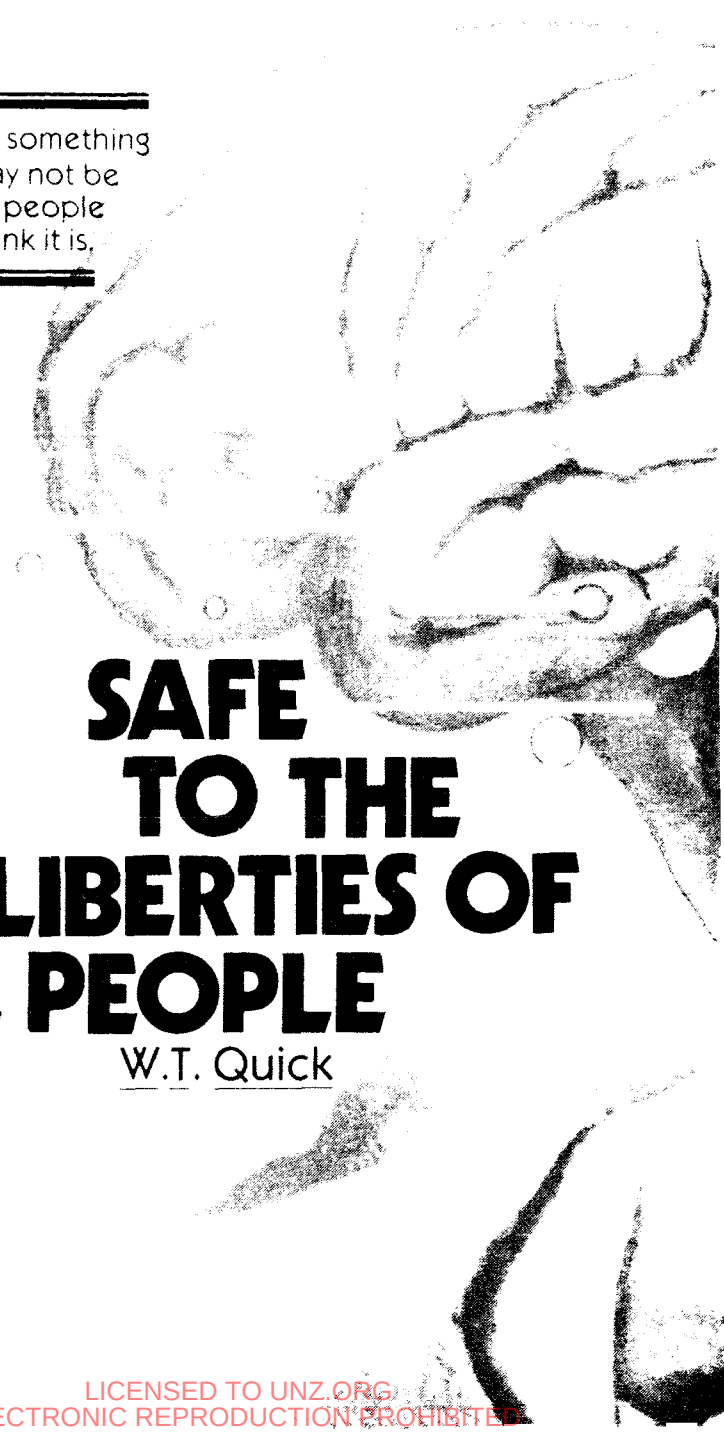
The reason something works may not be what people like to think it is.



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W.T. Quick

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Nicholas Jainschigg

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I have survived the Sputter War. The Russian Collapse. The Conglomerate Reconstruction. The Second Convention. Now, as I sit in my warm, old-fashioned study, it appears that I shall even survive time. At least the most recent issue of *Biotech Quarterly* hints at such a thing. The process appears in its formative stages, and certainly it will be expensive. No matter, I have a great deal of money. And it will only extend life perhaps two hundred years. That is enough. If true immortality is to be discovered, its secret lies hidden along the geometrically rising curve, and two centuries will be more than enough to ensure its discovery. It seems I will approach eternity as I have done most other things—in stages, gradually.

Pippin O'Rourke Adams, ever a scamp, has just released his second collection of "The New Federalist Papers." I have read the proof chip of it, and find that, as in the first book, I figure prominently. Pip delighted in gossip even when he was my impossibly youthful aide-de-camp, and it seems that the reading public does too. More power to him. I hope he gets rich as Croesus.

But even young—well, now not so young—Pippin missed a few tricks, though he was in the middle of much of the Second Convention's backroom doings. The matter about which I have now decided to speak, however, was not one for aides or special assistants or any of the other kinds of human backscratchers all politicians seem to acquire. It was real mano-a-mano stuff, the President, myself, and Jerry Graingford, and perhaps it was as earth-shakingly important as we pols like to think all our doings are. I don't know, but to this day, I still feel that if my life has any real meaning, any justification, it is tied up in those days in Denver, at the Second Constitutional Convention of the United States of America.

A bit of perspective here. The Convention, a nearly four month long monstrosity of political and social bickering, occurred in the euphoric aftermath of the Russian Collapse. Those of you too young to remember the feeling of relief in the western nations, after decades of nuclear anxiety, may find it hard to understand the incredible temper of the times. There was a sense of inevitability which followed the lifting of that spiritual load. All things seemed possible. And, naturally enough, many things were tried.

The former, and present constitutions both contain the clause which reads, "The Congress . . . on the application of the Legislatures of two-thirds of the several States, shall call a convention for proposing amendments, which . . . shall be valid to all intents and purposes, as part of this Constitution, when ratified by the Legislatures of three-fourths of the several States, or by conventions in three-fourths thereof . . . "

I was in my second term in the Senate. The major debates of the time concerned the various aid plans for what was left of the Soviet Union. My staff assured me that I was a lock for re-election. I held major seats on major committees. The world was a rosy place. And then, along came Jerry Graingford . . .

It was an elegant room. Thick burgundy drapes, white paneled walls, a

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deep blue carpet. Servants moved quickly and silently through the formally attired group, their white-gloved hands balancing silver trays full of drinks. The conversation level was cocktail chatter loud, punctuated by the rattle of ice against crystal. A faint haze of smoke filled the air, blue and ethereal in the warm glow of the lamps.

"He's an ass, Jenny, but a dangerous ass."

Senator Jenny Todd grinned at the speaker, a younger, very handsome man whose distinguished mop of pewter hair looked out of place above an almost-unlined forehead. Senator Todd bowed her heavy body forward slightly, pushing her rumpled, baggy face toward her companion's ear and whispered hoarsely, "I agree with you, Carl, but he is a very influential and rich dangerous ass. Do you follow me?"

The Honorable Carl Swenson, Junior Senator from the state of Idaho, grimaced. "The slimeball is financing the candidacy of my opponent through his damn Freedom For All Foundation. I may be a little prejudiced."

Senator Todd straightened back up, her heavy shoulders straining at the fabric of her formal jacket. She favored shapeless tailoring and thick, nubby fabrics. The days when rampant femininity was a prerequisite to election were in the past. Senator Todd was glad of it. Even in her youth she had been a plain, straightforward looking girl, radiating a fearsome intelligence. Age had sharpened that intelligence, but had done little for appearance. If anything, she was massively dignified. And she wore what she damn well pleased. "Need some help, Carl?" she said. "I can make a swing through for you. Just say the word."

Senator Swenson nodded. "I would appreciate it, Jenny. It doesn't look all that good. The guy spends money like he's got a pipe into the Mint."

"I think," Todd said slowly, "that is only one of the things Jerry Graingford would like to have." She shrugged. "Anyway, I'm serious. Have your people set up something with my staff. Two or three days. And maybe I can have you talk to some friends of mine, Carl. Graingford only acts like he has all the money in the world. There are others who have a bit, too."

Swenson, his dark, worried eyes hooded, grinned suddenly. "You really don't like the guy, do you, Jenny? Something personal?"

Todd sipped her drink thoughtfully. "It's all personal, Carl, isn't it? When you get right down to it?"

The familiar man behind the familiar desk in the familiar room began to speak. His voice was deep and serious.

"My fellow Americans," he began. He paused for a moment, his eyes steadily on the camera lens.

"You have made your will known. Three days ago, the Legislature of the state of Kansas voted to ask Congress to convene a Constitutional Convention. This was the thirty-eighth state to pass such a resolution, creating the necessary three-fourths plurality for such an action."

The President took a deep breath. "Therefore, in accordance with your will, a Convention will convene in Denver, in exactly two months, for the purpose of proposing amendments to the

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Constitution of the United States.. And may God be with us all."

An aide stepped away from the tangle of wires, cables, cameras, and technicians in front of the desk.

"Good job, Mr. President," he said. "Short and to the point."

"Frig Jerry Graingford," the President said.

Some of his very first memories were of the room. It was smaller now, because he was bigger. In his childhood eyes it had been huge, great sweeps of bookcases, massive furniture, tablelegs like a jungle made for crawling through, lights hung from the ceiling like distant stars. And the desk, where his father had done whatever his father did, his round, red face wreathed in smoke from the pipe he constantly smoked.

He had grown up in that room. But, sprawled behind the desk, puffing absently on his own pipe, he looked out of place. Not uncomfortable, not even as if he didn't belong there, but rather like the next door neighbor found unexpected in the living room.

Sometimes Jerry Graingford felt as if he had been the next door neighbor all his life.

He was tall and bony, with a long face topped by a bush of thick, unruly red hair. His eyes, two blue marbles in a glass of chilled liebfraumilch, were calm now, as he gazed down at the gooey bundle he held in his two knobby, reddened hands. Workman's hands, he thought, and sighed. So much work to do.

"You agree, kiddo?" he said to Gerrold Hensley Graingford the Fourth.

Little Jerry regarded him seriously, then opened his mouth and drooled.

"You think so?" his father said, wiping with gentle fingers. "It won't be long, not long at all. They kept me out of Washington, the bastards. They destroyed my father, but I built it back up. The people are fools, my boy, and their leaders are crooks."

He grinned an easy, lopsided grin. It made him look very young.

"Jenny Todd. Her friends, people like her. I'd warn you about them, about *her*, but you won't have to worry. By the time you are old enough, you won't even have to remember their names."

He paused, sighed, puffed gently at his pipe, jiggled the tiny boy carefully.

"Guh," said Jerry the Fourth.

"My sentiments exactly," his father told him. His gaze wandered away, reflecting glints from the magnificent chandelier overhead.

He sighed again. "I won't be President," he said softly. "But you will. Oh, yes you will."

The President and Senator Todd toasted each other silently. They were in the small office the President preferred for working conferences, or just conversations over drinks. The President, a man with a broken veins on his cheeks, a receding hairline, and a pot belly disguised by careful tailoring, wore baggy slacks and a blue sport shirt. The Senator was in a rumpled suit, but her tie was loose and the suit coat thrown over the back of her chair.

"Well, the sonofabitch got what he wanted," the President said. "I wonder if he really understands what he's let loose?"

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Todd tasted her drink and smiled. "It is the constitutional right of the people to call such a convention. Even if it's never been done before."

"We came close back in the eighties," the President replied. "Only two short, over the balanced budget amendment."

"At least there was a consensus on the issue," the Senator mused. "Look at some of the legislative resolutions we got this time. Gay rights from California. A poll tax from Georgia. No reason at all from Delaware." She snorted softly.

"That will be the corporations," the President said. "They are after something. Graingford's people, no doubt."

Todd shook her big head. "Some of them, but not all. It's just that nobody really knows what a can of worms we are opening here. The whole Constitution is up for grabs. If somebody packs that convention, they can damn well do anything they please."

"I wish we could have stipulated congressional appointment in the choosing of delegates," the President said.

"I don't know about that," Todd replied. "Graingford could concentrate his money in a few big states and dominate the selection process that way. Easier for him, maybe."

The President rattled ice cubes in his glass. "Any way appalls me. This convention appalls me. I guess two delegates from each state is the most equable. It's what is mandated, anyway." He rose from the chair and wandered over to the small bar in the corner. "How much do you think Graingford has spent so far?"

"That foundation of his filed reports showing a hundred million dollars."

"Humph. Lot more left, then. I wonder what he really wants?"

Senator Todd regarded her glass. "I'm sure we'll find out. Sooner than we'd like in fact."

The President turned and faced the Senator. "And will he get it, Jenny?"

"Over my dead body," Senator Todd replied.

The Hart Convention Center perched like a bird of concrete and steel on the foothills above Denver. Nyako had designed it. Some said it was the most beautiful structure in the world. The Demotechs had held two national conventions there, the Social Republicans, one.

The private jets landed at Stapleton Space Center in great, moaning droves. Delegates, two by two, fought their way through screaming packs of reporters, to retire into private suites all over the Mile High City.

Senator Todd surveyed her suite near the top of the New Palace Hotel. Sunlight danced and sparkled through the clear panes of floor-to-ceiling glass, picking up tiny dust-motes which the careful filtering of the air conditioners had evidently missed.

"You need sunglasses in this shack," Carl Swenson said.

"Rank hath its privilege," Senator Todd replied. She stared out at the glittering panorama of the Fort Collins to Colorado Springs axis. "I never told you how sorry I was, Carl, that Graingford got your number in that election."

The younger man grinned ruefully. "We did our best, Jenny. God knows, you tried hard enough, and thanks for it. Maybe it was for the best, anyway.

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I met those corporate people through you. Lobbyists make a lot more money than Senators, you know."

"Hah! Don't they ever. Listen, Carl, which way are your people going to swing?"

Swenson rubbed his forehead. His voice, when he spoke, was slow and careful. "They are big guys, Jenny. Industrialists, technocrats, conglomerates. Their interest will be in their wallets, as usual."

Todd glanced at him, a sardonic quirk on her meaty lips. "And you, Carl?"

"You know how I feel about the asshole. But I represent my people."

"Don't we all," the Senator replied. "But your constituents aren't completely ecstatic, are they?"

Carl Swenson laughed. "They're scared shitless. This is the biggest poker game ever, and business folk don't like uncertainty. But since there has to be a game, they're sure as hell going to play."

The Senator turned from the window, her heavy shoulders sloping faintly down. "And Graingford will have his people, too. I've heard some strange rumors from that direction. How about you?"

"A development in one of his companies. Something scientific. I don't see how it would bear on all this," Swenson replied.

"The man is a snake, Carl," Senator Todd said. "Maybe we should try to find out."

There were about a hundred folding chairs arranged in rows in front of the podium in the large, high ceilinged room. The noise level from the reporters, with their attendant cameramen and technicians, was deafening. Finally, the door behind the podium opened and a tall, red-headed man entered, smiling lopsidedly at the crowd. He climbed to the lecturn and raised his hands for quiet.

"Hello, everybody," he said.

The room was suddenly silent, except for coughs and the occasional muttered, "Get the *hell* out of my way."

"I'll read this statement first," Jerry Graingford said, "and then you can ask all the questions you want." He paused and straightened the papers in front of him, grinned faintly, and began to read.

"About two weeks ago, a piece of technology one of my companies had been developing reached a stage where we felt it was worth bringing to public attention. That is, it had passed enough tests and we are now ready to bring it to market."

He lifted a glass of water to his lips.

"We call it PCT, which stands for public communication transfer. Now, I know that doesn't tell you much, but what it boils down to is a way for the public to make its wishes known, and enforce those wishes. It works like this."

There was a stirring in the audience, and puzzled looks exchanged.

"We have developed a certain kind of brain implant which, in use, can receive outside signals and transfer them into various kinds of sensations inside the human brain. Fear, happiness, pleasure, pain, sadness, and the like. The use of this invention in the fields of psychology and psychiatry, to name but two, is very promising. However, I have envisioned another possibility,

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which may have bearing on the situation in the United States today."

He raised his head and searched his audience with eyes suddenly blue as searchlights in the arctic.

"We now have off-the-shelf technology which, if coupled with this new development, will let the average American directly influence his government as never before in the history of man. Almost everybody has a video set. Most of these sets, for purposes of advertising, census, or whatever, can communicate to a central point instantly. Our system can transfer these electronic messages into any signal we desire within the minds of those equipped to receive them. The significance of this is profound, especially for those who have followed the sad demise of our representative system of government, a system which no longer represents anybody who doesn't have money, or power, or both."

He stopped suddenly, then cleared his throat. "Questions?" he said.

Many of the reporters and commentators still looked puzzled, but a few plants, already primed with the right questions, raised their hands. Graingford pointed at a short, rotund man with red lips and a shiny skull. "Yes, Allen?" he said.

The little man stood. "Mr Graingford, if I understand correctly, what you are proposing is to, ah, 'wire up' government officials to this contraption of yours, so that each citizen can somehow communicate with them?"

"Well, Allen, communicate is right in the broadest sense, but no, I don't mean that you could send little messages to these people. Who could handle three hundred million voters whispering in your ear all at once?"

The group chuckled lightly.

"No, but what we could send would be emotional messages, like the ones I mentioned before. Sadness, happiness. Like that."

The small reporter nodded pompously. "Or pleasure and pain?"

Jerry Graingford grinned. There was something lopsided about that showing of brilliant white teeth. "That, too, Allen." He paused, then grinned again. "After all, a kick in the pants for some of these people wouldn't hurt at all, would it? To remind them who they truly represent, when they're off in Washington, voting for another pork-barrel corporation giveaway?"

The room exploded with noise.

"Here is the problem," Senator Todd said to Carl Swenson. "If Graingford gets this amendment of his pushed through allowing the use of that damned hookup of his, the entire structure of constitutional government in this country is changed. People don't realize it, but the intent of the framers of the Constitution, men like Adams and Hamilton and Jay, was to limit the power of the rulers—and in the case of the United States, the rulers are the people. Which is why we have representational government—the people elect Congressmen and Senators, who then exercise the power of governing, without being 'questioned in any other place,' as Article I sets out."

The two were talking quietly in Todd's suite, seated across from each other next to the tall window. Outside, a wave of stars rolled over the Rockies, matched

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by the glittering carpet of light spread on the plains below. The room was quiet, and smelled of cigar smoke. A half-empty bottle of Dewars and an ice bucket rested on the coffee table between the two of them.

Swenson shook his head. He was wearing jeans and a t-shirt with the words "Rocky Mountain High" on it. "It's going to be a tough sell, Jenny. That's exactly what the people *think* they are, the rulers, and, in reality, they are. The people have the power to make any change in the Constitution they so desire. As this convention demonstrates."

Todd's blouse was unbuttoned, exposing her heavily creased neck. Her belly bulged over her rumpled, tweedy skirt. Her thick, lined face sagged more than usual. "Why do you think it is so difficult to change the Constitution, Carl? Our entire system of government is designed to control the momentary passions of our rulers. That's what the framers were afraid of—government by whim. Every democracy prior to ours has failed because of that one reason—the people have voted their form of government out of existence. Our system guarantees, or tries to, that there will be thought, debate, and compromise before radical measures are tried. Graingford says his system will guarantee that the will of the people will be done. Sure—but is that will always the best thing? How many bad pieces of law have we enacted, only to breathe a sigh of relief when the House wouldn't go along, or the President, or even the Supreme Court? Popular feeling is a wonderful thing, but what about the really awful piece of legislation that is overwhelmingly popular? Something like, oh, this amendment of Graingford's, for instance. That piece of garbage wouldn't last ten minutes in the Senate."

Carl Swenson nodded. "Which might be why we are having a convention in the first place."

Todd poured a hefty dollop of scotch into her glass and added one ice cube. "I suspect this is what he's been after all along. His communications companies help to run the global village. He can create enormous popular movements, almost overnight. Imagine what could happen if that kind of pressure could be translated into immediate, physical influence on the Congress? You know our colleagues—could some of them face even a headache, let alone the kind of punishment Graingford is talking about, for voting *against* an extremely popular bill? Yet that's the genius of our government—the bad bills do get voted down, even when the people want them."

Swenson sighed and stretched. His knees made a cracking noise. "I understand what we're talking about, Jenny, but even as we talk, I wonder how to explain it to my own people. Too many of them see this as their own pipeline to direct power. Their influence is based on their wealth, and this thing is tailormade for them. It's going to be tough to convince them to oppose it."

"We will have to, Carl. A tyranny is a tyranny, whether it's run by a king or a dictator or the great and wonderful people themselves."

"That sounds kind of elitist, Jenny."

Todd snorted suddenly. "Face it, Carl. Our system *is* mildly elitist—it was intended to be—but it has given

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more people more freedom than any other system in history, and for a longer time. I don't particularly buy, 'if it ain't broke, don't fix it,'—things can often be improved. But I won't go along with an idea that means, 'if it ain't broke, let's break it.' I would betray my own oath of office if I did."

"Mr. Graingford is whipping up an awful lot of enthusiasm for this thing. The delegates are starting to feel the whip." Swenson said slowly. "We are opposing a mountain, Jenny."

Senator Todd downed the rest of her drink and stared out at the stars. "There is always honor," she said at last.

"He won't debate," Jenny Todd said to the President.

"Why?" asked the President. He was seated behind the great desk in the Oval office, his signature swivel rocker turned toward the long green windows. Outside, dusk was slowly hiding the muddy foliage of Washington. "The way things are going now, he would probably win."

Todd turned her head slowly back forth, stretching tired neck muscles. "The operation hurt," she said. "It still hurts."

"You're an old woman, Jenny, whether you want to admit it or not. Hell, I'm an old man. But I'm not senile enough to have that frigging implant stuck in my skull."

"If we don't beat him on this, you may have no choice in the matter. You know why I did it. He talks about how wonderful this gadget of his will be. Well, let him prove it. Let him debate me, both of us hooked up to his national net. He wants the people to judge. Let's see if he is willing to submit himself to the same kind of thing he wants us to undergo. I'm banking that he won't, and that will be the wedge I need. How can he push it if he won't go for it himself? I'll beat him to death with that club."

The President turned his chair back to face the Senator. "And if he accepts? You aren't the young thing you used to be, Jenny. And I know about your heart condition."

A startled look crossed Senator Todd's puffy, drooping face. She looked for a moment like a startled hound. "How do you know about that? Only my doctor—I was planning to retire after this term . . . "

The President grinned his famous craggy grin. "I'm the President, Jenny. I know a lot of things. Some of them I don't even want to know, but they tell me anyway. Sorry. How bad is it?"

Todd laughed. "You mean you don't know? Hell, Jack, it's not that bad. I've got a few years left. More than a few. I'm going to retire, not die."

The President stared at her. "I repeat, and if Graingford accepts? He's not even forty yet. Young. Strong and healthy. Nothing wrong with his heart."

Todd's dark eyes bored into the man before her. "We will cross that bridge when we come to it. But he won't accept, Jack. He can't."

"Why not?" the President asked.

"Because he is a coward," Todd replied. "Just like his father."

He sat in the great, shadowed room, his eyes hooded. The chandelier overhead was off, the only illumination coming from a small banker's lamp on his desk. He stared at a gold-framed

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picture which portrayed an older man, but the red hair and long jaw were echoed in his own face.

"She fell for it, father," Jerry Graingford said. "Swallowed the bait in all her greed and arrogance. And now I will smash her. I will beat her, defeat her arrogance, and I will crush *her* as well. Nothing will be left of Jenny Todd. And that will be the end of it, father."

He sighed, a ragged, hurtful sound. "At last, that will be the end of it."

The lights overhead in the room at the apex of the Convention Center were hot as miniature suns. Jerry Graingford sweated under those lights.

"Mr. Graingford," Cameron Falls said in his clear, assured voice, "from your opening statement, it appears that you believe the people will be best served by a more direct representation in their government than they now have. Can you comment further?"

Graingford's hair shone red and gold as he bobbed his head. "Absolutely, Mr. Falls. Decades of recent history have shown that Congress has become a plaything of massive special interests. The common man has no real voice. Is it any wonder that less than a third of those eligible actually vote? Why bother? Everyone we elect goes off to Washington and proceeds to ignore the voter from then on, listening only to those with money or influence to help them get re-elected. This amendment would put power back where it belongs, in the hands of the people."

Falls turned to Senator Todd. Her massive body was as unmoving as stone, her eyes glittering.

"Senator Todd?" he said.

"Leaving aside that Mr. Graingford is much more one of the rich and powerful than he is a member of the common people he so admires, I think we need to examine the original intent of the men who framed our Constitution. It is a popular myth that the Founding Fathers created a democracy. Not so. We are a republic, and there is a difference. Let me speak the words of James Madison, from his defense of the proposed Constitution in *The Federalist Papers*." She stopped, picked up an ancient, well-thumbed book, opened it carefully, and began to read. " 'It may be concluded, that a pure Democracy . . . can admit of no cure for the mischiefs of faction. A common passion or interest will, in almost every case, be felt by a majority of the whole; . . . and there is nothing to check the inducements to sacrifice the weaker party, or an obnoxious individual.' What this means, in all simplicity, is that in a pure democracy there is no protection for the minority against the majority. We are a nation ruled by the people in all ways. What the Founders feared was the fear shared by all thinking men—that the ruler may become a tyrant. This is the essential protection built into our system, that the will of the majority cannot become a tyranny over the minority, even a minority of one. And this is what Mr. Graingford proposes to strip away. One might further ask, since my opponent owns or controls almost half the means of communication and public opinion formation in this country, just who he intends this amendment to benefit, really? He certainly has the ability to create a 'common passion of interest,' which Madi-

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son also called, 'the mischief of faction.' "

Graingford nodded slowly. "Oh, yes. *The Federalist Papers*. Written in the late eighteenth century, and about as relevant to today's problem as a belief in witches. But since you quote from it, let me mention the comment of a contemporary of Madison's on the same issue. Patrick Henry—you have heard of him, I presume—said, 'If ten men be better than one hundred and seventy, it follows of necessity that one is better than ten—the choice is more refined!' Henry was speaking in sarcasm, of course, arguing against Madison's proposal to limit the representatives of the people to a small number of congressmen. Patrick Henry, at least, favored direct representation by the people in their govenment—as I do."

"And Patrick Henry was voted down—as he should have been," Senator Todd replied. "The document the majority of his peers then created has another advantage—it has stood the test of time. Our democratic republic exists today, longer lived than the Greek democracy, less changed than the French. We are a free nation because the founders hedged our constitution with safeguards to protect us from ourselves. Right or wrong, it has worked."

Graingford's lips tightened slightly. He took an oversized white handkerchief from his pocket and mopped his long forehead.

"If," he said, "the founders intended the Constitution to be a perfect document, than why did they make provisions for it being changed?"

"Change is one thing," Senator Todd replied. Her heavy gaze fell steadily on Graingford. "Destruction is another. Self-interested destruction is a third. Why, Mr. Graingford, have you poured your millions into this issue? Why has your foundation, Freedom For All, blanketed every advertising medium with scorn for me, personally? Why do you attack me personally at every occasion? Is it because of this debate? Is it because of this odious technological thing in my skull? Did you hope to influence me with a wave of public opinion tranformed into agony inside my mind? Did you hope, for God's sake, to *frighten* me? Then let the people see what you would force them to do with those they choose to represent them."

"You accuse me personally," Graingford replied. His blue eyes were lanterns. There was a tiny whine in his voice. "This is a debate. It is on the issues. It is not personal."

Senator Todd's voice snapped like a whip. "It is all personal, Mr. Graingford. It always is. Let us tell the people of our personal history, so they will know our personal relationship, and why you hate me, and why you have created this monster to destroy me."

The Senator stopped for a moment, her breathing hoarse. Graingford glared at her. "This has no place—" he began.

"It has *every* place," she replied. "You want the people to judge? Then give them the truth, so they can judge rightly! Tell them how I was engaged to your father. Tell them how my father, thinking the match a mistake, threatened your father. Tell them how your father gave in, and broke our engagement. And then tell them how, later, my father destroyed your father's business. Tell the people why you hate me, personally,

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Mr. Graingford, and explain again your unbiased interest in better government."

The Senator stopped, then raised her finger triumphantly. "Tell them the truth, Mr. Graingford."

Graingford's hands visibly quivered for a moment. He grasped both sides of the podium and straightened slowly. His face relaxed after a moment, and he began to speak steadily.

"Madame Senator," he said. "You ask for the truth. Very well. All that you say is the truth. I admit it. I admit that I hate you, and what you stand for. But what do you stand for? You come from a rich and powerful family. My father, who dug ditches in the beginning and built that into a thriving business, wasn't considered good enough for that family, or for you. And so my father was threatened by yours, and he gave way, not wishing to lose what he had built with his own sweat. Even so, it was not enough. Your father had to make sure that the threat was gone, and so he, and his friends, exercised the power of their clique, and destroyed my father. Your father didn't even keep his bargain, and there was no force strong enough to stop him. No place for my father to appeal for protection. Just as there is no place for the people of this country to appeal, when you and your friends run the government like a private club!"

Graingford slumped suddenly, and stepped back from his podium. His voice was soft. "You seek the truth, you say. Well, there it is, and there are my reasons. I want this amendment to prevent what happened to my family from ever happening to another American family. And that is the truth. So, are you ready now? Are you willing to let the people decide? *Are you ready for a vote?*"

Senator Todd refused to look at her opponent. Instead she faced the videocameras and slowly spoke. "I have nothing to fear," she said steadily. "Of course, let us vote."

On millions of video screens across the nation the placid face of Cameron Falls appeared, and countless rooms were filled with his unctuous voice.

"The debaters have agreed to a vote," he said smoothly. "For those of you who have not already received instructions, the process is a simple one. Just program your video receivers with either 'yes' if you favor passage of the Amendment Mr. Graingford backs, or 'no,' if you support Senator Todd's position. A central unit will tally the vote, and the results will be translated in sensations of pain or pleasure within the minds of the two debaters." The commentator paused, then smiled cheerfully. "That's really all there is to it."

The screen flashed back to a picture of Jerry Graingford and Jenny Todd facing each other. They were silent. Graingford had his thin lips spread in a mocking half-smile, while Senator Todd watched him with absolutely no expression on her thick, drooping features whatsoever.

The change, when it began, was slow, as the thousands, then millions of votes began to make their effect. Finally, everybody could see the grin on Graingford's face begin to loosen, and widen. His pupils dilated. He began to shudder gently.

Senator Todd stood up straight, then arched her back slowly. Her mouth opened and showed teeth. A tic began

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to jump in her right cheek. Finally, her eyes bulged.

She seemed to make an enormous effort at control. Her lips, twitching under an unseen charge, began to form words.

"I . . . loved . . . your . . . father —" she got out, as saliva ran down her chin in a shining chain. Then, like a mountain crumbling, she slowly toppled over. . . .

. . . and I caught her as she fell. We buried Senator Todd one week later, in Arlington Cemetery, as she wished and was entitled.

Two days after the funeral, the President summoned me to the Oval Office. It was a drizzly, overcast day, shot full with gloom. The President remained behind his desk the whole time of my visit. When the Secret Service agent opened the door to the office and waved me inside, I knew why I was there.

Jerry Graingford sat on one of the sofas against the side wall. The President stood and said, "Hello, Carl." He nodded at Graingford. "I presume you two know each other?"

Graingford stood and extended his hand. I ignored it. "We know each other," I said.

"Don't want to shake hands?" Graingford said. "Well, let's be honest. I don't want to shake with you. Either of you, for that matter," he said.

The President seated himself. "We are probably all agreed about that one thing, then. I doubt that we agree about much else."

"Why am I here, Mr. President?" Graingford asked.

The President grinned at him. "To witness your own destruction, of course."

Graingford stared at him. "I beg your pardon?" he said.

"You heard me," the President continued. "What you are going to do, Jerry, is withdraw support from that damned amendment of yours. And you are going to retire from politics. You can go to hell, for that matter, but you are done now. Finished. That is why you are here. So I can tell you, and Carl can hear me do it." He paused, nodded once. "Or you can fight. I would like that. Then we will destroy you completely. Your choice."

There was a silence. It must have seemed to Graingford that he was replaying the same scenario his father had undergone, that of great powers combining to threaten him. Suddenly he threw back his long, bony head and laughed. It was a harsh, braying sound.

"Old man," he said. "You're a joke. Both of you. Maybe you're senile, Mr. President. Whatever. If you brought me here for this, you made a mistake. The old woman is dead. She was your best shot, and I killed her. It's over. And I am leaving now."

He nodded shortly at the President and turned.

"She knew she was going to die," I said mildly.

Graingford stopped. "What?"

"She knew it. She wouldn't admit it, but all of us knew. And planned for it."

"What are you talking about?" Graingford said. "Are you crazy?"

"It turned the tide, you know," I continued. "She had so much stature. The corporate people respected her. She understood them, better than you do. She knew the one thing they all fear is

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change, a threat to order, revolution. And by her death she revealed that you are all of these things. Damn it, Graingford, didn't you realize she *was* the establishment, and by killing her you threatened them all?"

I shook my head. "I guess you didn't, because you killed her. On worldwide video, in living color, in front of a billion people. They didn't like it either, all those people. Deep down they know who pushed the button. They did, each time they voted, but they won't accept that, accept the truth and call themselves murderers. So they will shift the blame to you, Graingford. With a little help. I, and my friends, will see to that. Believe it."

Graingford swiveled back and forth between me and the President. His blue eyes glowed. He wasn't stupid, by any means. He didn't quite believe it, but he understood what we were saying. Then he stopped, and his lips clamped shut.

"Well, then, we will see, won't we? Perhaps I may have made some small error on this matter. But time will decide, won't it, gentlemen?"

The President shrugged. "I suppose it will. I have been neutral in all this, publicly, at least. But not any more. You may find my speech tomorrow to be of interest." The President showed his teeth, and a few people might even have called it a smile. "Your Amendment is a weapon against you now, Graingford. And you gave it to us. You and Jenny Todd. Now get out of here."

I stood as Jerry Graingford left the Oval Office. It was the last time I was ever in the same room with him.

"Are we right?" I asked the President. "All this collusion and conspiracy to defeat one man and his idea? Do we have any moral position in what we are going to do?"

The President slumped tiredly in his chair. "The founders knew what we are, Carl. Men, and money, and power, and interests. This nation is of the people, by them, and for them, and those men knew what people are. Never forget, we are all one. They didn't forget—which is why they designed the Constitution as they did. Madison put it best, when he said, 'It may be a reflection on human nature, that such devices should be necessary to control the abuses of government. But what is government itself but the greatest of all reflections on human nature? If men were angels, no government would be necessary.' "

The President smiled sadly. "Madison also promised us that the Constitution would be ' . . . safe to the liberties of the people.' Even as we do this thing I believe that. And it is enough for me."

Me, too, I guess. Jerry Graingford lives on today, immensely wealthy, and quite powerful in many ways. His son appears, from the video gossip columns, to be a nice young man, mad for space and the outer colonies like so many others of his kind.

And I sit and ponder a future that may include immortality, and wonder how our nation and its Constitution will weather the future to come.

I will probably live to see that future, and I am not afraid. I just remember Senator Jenny Todd, and remind myself that we are a nation of laws, but we are a nation of honor, and sacrifice, as well.

It will see us through. ■

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The Alternate View
RECENT RESULTS
John G. Cramer

This Alternate View column marks three milestones: This is the 3rd anniversary of my start as an AV columnist for *Analog*, this is the 20th AV column I've written, and it is also the 7th anniversary of my first publication in *Analog*. I enjoy writing these columns on scientific subjects, but it can be frustrating. Science is continually changing as new experimental results and observations are made, as new ideas and theories are conceived and old ideas are rejected. Often by the time an Alternate View column on some new development in physics or astronomy appears in these pages the field has already progressed further and there is more to be said. So this third anniversary column will be used as an occasion for a backward look at some of the subjects covered in previous columns and articles, giving an update on more recent developments. An index of my AV columns and articles is provided below. This can be used as a reference guide to indicate which topics were discussed in which columns and articles.

The CU-CU Maneuver (Column 4)—The Mid-December 1984 issue of *Analog* was a special Kelvin Throop humor issue, and for the occasion I announced the formation of the *American Association for the Retardation of Science and Engineering* (acronym: AARSE) which each year presents *Gold Plated AARSE Awards* to those who have done the most in the recent past to retard the progress of science. Among the lucky winners of the 1984 presentations were Columbia University and Catholic University in recognition of their achievement of inventing the CU-CU maneuver, persuading a powerful congressman (Tip O'Neill) to place in the Department of Energy (DOE) budget a "nest egg" starting construction of $34 million in new buildings on the Columbia and Catholic U campuses, preempting money intended for the support of ongoing research in nuclear and particle physics. The other "baby birds" are thus pushed from the nest in the style that the cuckoo has demonstrated so successfully in the avian world.

Now, from a perspective of several more years, the CU-CU maneuver has proven its staying power. It has been used with great effectiveness by more than a dozen universities with strong congressional clout and flexible ethics to raid budgets not only of the DOE but also of the Departments of Defense, Commerce, and Agriculture, and the National Institutes of Health. Academic pork barreling is now a growth industry, and the use of the peer review system for the selection of worthy scientific projects has become the "old fashioned" way of obtaining federal funds for university research. We have these distinguished institutions to thank for this contribution to creative finance. If there are future presentations of Gold

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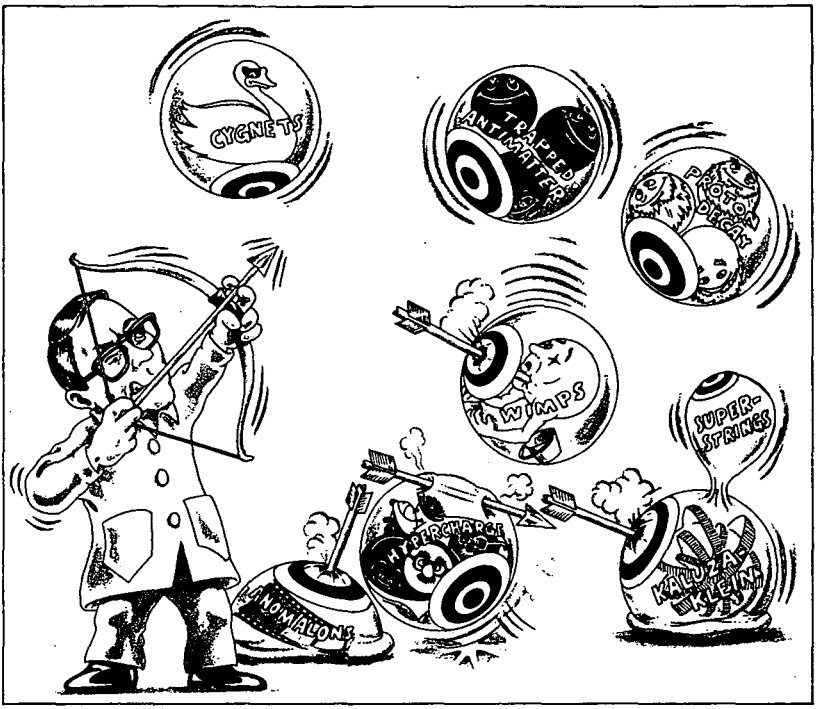

Illustration by William Warren Jr. 1987

Plated AARSE Awards. Columbia University and Catholic University are certain to be strong contenders for this highly sought-after distinction.

Proton Decay (Columns 1, 9, and 12)—There are four large underground experiments that have been searching for the decay of the proton for over three years now. At this writing (11/86), not one verifiable proton decay event has been observed in these experiments. This negative result has eliminated the grand unified theories (GUTs) that predicted an observable decay of the proton into lighter particles (a positron and a π^0 meson, for example). Fortunately, there are plenty of GUTs to go around. The surviving theories predict that the proton has such a long decay half life as to make proton decay experimentally unobservable. The universe seems to be made of more durable stuff than we had expected. Woody Allen should be pleased.

Cygnons and Cygnets (Column 12)—A spin-off of the massive experimental effort to detect proton decay is that quite unexpectedly some of these experiments have observed mysterious neutral particles coming from Cygnus X-3 (see also the discussion in "Stranger than Fiction: Cygnus X-3," *Analog*, Mid-Dec.'86). My column 12 used the term "cygnon" for the unknown particle because this terminology was used by one of my references. However, the

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editors of *Physical Review* are sticklers on terminology and naming, and they decreed that the new particles are to be referred to as *cygnets*, not cygnons. As yet, there is no new experimental information on what these particles are, but the speculations continue.

Anomalons (Article A3)—Anomalons are the "accident prone" nuclei discussed in my 1983 science fact article. They were "discovered" in emulsion experiments with cosmic rays and with high energy heavy ions at the Lawrence Berkeley Laboratory. Shortly after this *Analog* article was printed, they were christened "anomalons" because of the anomalously short distance they show between successive nuclear collisions. Since 1983 there have been a number of experiments designed to learn more about anomalons. It has become clear from these experiments that the anomalon is not a new particle. Unfortunately, it is an artifact of the emulsions in which they were "observed." This is one more case of an apparent "new phenomenon" that has been revealed as spurious.

The Solar Neutrino Problem (Column 13)—This column was written approximately a year ago about the Brookhaven solar neutrino detector, which for the past decade has detected only ⅓ of the expected number of neutrinos from the sun. In the past year a new solution to the problem of the missing neutrinos has been proposed. Neutrinos as they pass through the sun, should interact with the high density of electrons in the sun's interior. This interaction, under the right circumstances, can convert electron neutrinos into muon neutrinos which are undetectable by the Brookhaven apparatus. This explanation is now being taken quite seriously. It requires that electron and muon neutrinos do not have zero mass, but instead have extremely small masses, perhaps a billionth or less of an electron mass. This new theory has given added stimulus to the construction of new kinds of neutrino detectors using gallium or heavy water as the detector material. The lower energy solar neutrinos detected with these new devices would provide a stringent test of this new theory.

The Fifth Force (Column 15)—At this writing (12/86), a year after publication of the theoretical paper suggesting a fifth force, the possible existence of such a force has *just* been tested and disproved. None of this experimental work has yet been published, but three preprints of submitted papers are now circulating. Of the three, the experiment that is by far the most sensitive was done by colleagues of mine at the University of Washington using a tricky torsion pendulum. It convincingly eliminates the possibility of any hypercharge dependent intermediate range force having a range of more than a few centimeters.

The demise of the fifth force is a blow to science fiction. We really *needed* some physically plausible anti-gravity device. Larry Niven, for one, has already been conjuring up "floaters" to provide trouble-free transportation. These would even have avoided large buildings and mountains (by repulsion) in the event of driver inebriation.

Antimatter Stars and Galaxies (Article A1)—My first science fact article for *Analog* in 1979, "Antimatter in the Universe" was a popular version of a

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paper that I had just published in Physical Review Letters. It described a way of telling whether a star in the process of supernova in a distant galaxy was made of matter or of antimatter. At the time the article was written, the possibility that neighboring galaxies might be made of antimatter was still quite a live issue. Since 1979, however, both experimental evidence and our understanding of cosmology have lead us to the strong conviction that the universe contains essentially all normal matter, with no antimatter stars and galaxies. Active stars produce a stream of protons called the "solar wind." For antimatter stars this would be a fairly strong source of antiprotons streaming into space. But measurements of the antiproton fraction in cosmic rays show only the tiny fraction of antiprotons produced by the collision of very high energy protons in cosmic rays with random gas molecules in space. Moreover, the energetic gamma rays produced when antiprotons annihilate with normal matter are not seen in the quantities expected if nearby galaxies were sending antiprotons in our direction. There are also theoretical grounds from GUTs cosmology for expecting that the stars and galaxies of the universe are made of matter, never antimatter. Thus, the nifty trick for detecting an antimatter supernova has lost much of it's appeal because no antimatter supernovas are expected.

Trapped Antiprotons (Column 10)—The column described plans of a group at the University of Washington to trap accelerator-produced antiprotons in a Penning trap. Those plans were successful: in July of 1986 the group trapped about 6,000 antiprotons from a beam supplied by the LEAR facility at the CERN laboratory in Geneva, Switzerland. The protons were slowed by passage through matter and passed into a strong cylindrical magnetic field. Electric "barrier fields" at the ends of the cylinder were switched on as the antiprotons passed through, trapping low energy protons in the system. They remained in the trap for several minutes until they finally were annihilated by combining with random gas molecules in the system. This was only a preliminary test, and both the trap and the vacuum system of the apparatus will be greatly improved before the work continues next year. But the very significant accomplishment of trapping a quantity of trapping antimatter essentially at rest has now been achieved. The use of antimatter as a material for use in laboratory experiments is no longer science fiction. The group plans to make detailed tests of matter-antimatter PCT symmetry. They also plan to combine antiprotons with positrons to form anti-hydrogen atoms and to address directly the question of whether anti-hydrogen falls down or up in a gravitational field.

Extra Dimensions (Column 6)—The Klein-Kalusa theory described in this 1985 column uses a total of 11 dimensions: time, the three normal space dimensions, and seven "compactified" dimensions, to explain the four known forces of the universe in terms of extra-dimensional geometry. Since that time, however, a modification of the pure Klein-Kalusa theory called "superstring theory" has taken precedence and now is the focus of much of the activity in

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theoretical particle physics. Superstring theory (see "SUPERstrings" by Margaret Silbar in the February '86 *Analog*) describes fundamental particles like electrons, neutrinos, and quarks as tiny loops of "string" in a 10-dimensional space. Like the Klein-Kalusa model the extra dimensions in superstring theories are "compactified," connected back on themselves in tiny loops. But because the superstring itself provides an extra degree of freedom, there need be only six of these compactified dimensions in the superstring theory. Moreover, the prospect that there could be as many as 40 of these compactified dimensions is dimmed by the superstring theory because the symmetry of the system dictates fairly unambiguously that there should be no more than nine space and one time dimension.

One interesting prediction made by superstring theories is the possible existence of "shadow matter" in our universe. Shadow matter particles are much like the familiar particles (quarks, electrons, etc.) of our world. But shadow particles interact only with each other, not with normal matter. We would notice them only through the gravitational effects of their mass. This raises the possibility that our universe is really two universes in one, each universe remaining aloof from the other and interacting only through the mutual force of gravity. ■

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* Title was misprinted in **Analog**; the correct title is given here.
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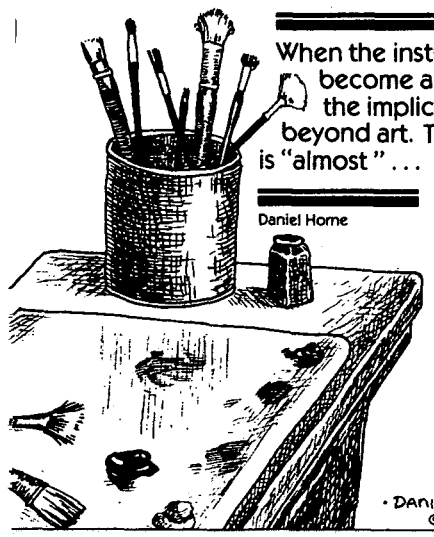
Rob Chilson

BRAIN JAG



When the instrument and the artist become almost inseparable, the implications go far beyond art. The key word is "almost" . . .

Daniel Horne

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"Artist in jail? No, he's out on bail." The desk sergeant looked at him with some interest.

Professor-Emeritus Allen Morea looked wryly back. "I have here a court order—I'm supposed to be some kind of tom-fool witness in the case—"

The sergeant took the order, scanned it, then his eyes lit up. "Oh, right, you're the art expert, to look at the painting. It's down in the evidence room. You gonna be long?"

"Longer than I'd like. I really can't say, Sergeant. Not more than an hour—make you a promise."

"Well . . . you shouldn't be down there without someone watching you, but we can lock the inner door. . . ." The other stood and led the way out of the room. "I'm short-handed at the moment, Professor. By the way, what is it about this case? I never heard of anything like it. This Lindine Polk stole another artist's pocket brain, is that it?"

"So they tell me. That is, the other artist, what's his name—Jesus Sanchez—says he did. Polk claims he just borrowed the confounded thing."

The sergeant grunted knowingly as he led the way down dank concrete steps. "Like these kids that steal cars for a night—just borrowing, they say. We get these car jag cases all the time. We usually don't treat'em too rough." He glanced over his shoulder, in imminent danger of falling, causing Professor Morea to tense and grip his cane tightly. "But they're just kids, Professor. This Polk's got to be thirty-five. Pocket brains are cheaper these days, but they're still above the minimum for felonies."

He paused to fish out keys and unlock a creaky door. It was painted a bilious green, and the room within was dark but for a single bare bulb dangling from a cord, perpetually burning. The walls were lined with shelves, most empty, a few holding oddments: a cracked plate, a cigarette lighter, a plastic garbage bag, an ashtray, and so on, all tagged. There was a shifty-looking table. To one side was a more sturdy door, which the sergeant unlocked with some effort. It moved with well-oiled ease, and disclosed a much more elaborate room, or series of rooms, full of much more interesting objects.

Even as Professor Morea watched in fascination, a uniformed policeman came in behind him, glanced sharply at him, and entered the other room. There was a brief exchange and he emerged, lugging a thick canvas sack full of various oddments. Then the sergeant reappeared, carefully holding a large painting, three feet by four. Acrylic on canvas. He turned it to the light, panting a little—it wasn't heavy, but it was awkward, and he'd had to maneuver it through the door.

"That okay, Prof?"

It wasn't, the light was totally inadequate, but Morea thought better of complaining; he doubted if this helpful sergeant, court order or no, would lug the thing up to a better light. He nodded reluctantly, staring at the painting.

"Yeah, this Polk fellow can claim it was just a jag, a borrowing, but it's grand larceny if the other fellow wants to push it."

He left Morea to sit and study the painting. The two folding chairs in the room looked equally uncomfortable. Choosing the one already unfolded, the

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professor eased his skinny hindquarters onto it gloomily.

The painting was representational, though hardly photo-realistic. It was a landscape, unlike most of Polk's current work. Morea knew the artist slightly. It was a high-key piece, the colors intense: lush greenery, mountains dramatic in the background, the ruins of a Mexican step-pyramid in the middle distance. The brush-strokes were loose, bold, vigorous; the flowers were impressionistic splashes of color.

There was a nice effect with one bright red bird, which was merely glimpsed as a pair of brush-strokes, a blur of motion, superimposed on the greenery and the distant mountain. This was the center and focal point of the picture.

Morea conscientiously studied it for a long time, close up and from a distance, oblivious of the occasional comings and goings of policemen. Presently he stood, stretched his wiry frame, and went to the door. He didn't like to leave it unlocked, but wasn't going to try to shout up the stairs. At the top of them he found a different officer on duty, told him that the door was unlocked, and left.

"A fool's errand," he muttered, struggling into his car in the chill of the early-winter evening. The car's engine was cold and balky, and Morea's bones sympathized. "Goddamned mechanic! Now, which one's nearest?"

Sanchez lived closest. Presently Morea was ringing the bell on a door in what looked like University housing: trim pale brown stonework with concrete casements, dark hardwood doors.

Sanchez and his woman shared the place with other artists. A sturdy redhaired girl whom Morea thought he remembered from one of his courses frowned at him and turned to yell into the house. Presently Jesus Sanchez appeared. Morea knew him by sight; the other knew him also. Sanchez's face lit when he saw the professor.

"Good to see you again, Professor." He pushed wide the door and helped Morea off with his coat, the redhead taking the cane. "I had one of your courses two years ago. Thelma, Bacardi and Coke for the professor."

"Not too strong, damn it. Doctor's orders, and besides, I need my wits, besides which I'm driving. Why don't you go back to Puerto Rico, Sanchez, or wherever you came from? They don't have snow there."

A blond man scowled up from a computer where he was doing layouts, but Sanchez laughed. "Going to have snow, are we?"

"Before morning, or I wasn't born in Maine." Morea looked at the computer screen with distaste. Of all the artists in the house, only one, Sanchez, was a *real* artist. The only one who actually *painted*. There was only one easel to be seen, and four computer screens.

At one of these the blond artist sat, his right hand on a mouse and his right arm flaccid. Eyes half closed, he was visualizing in careful detail the scenes that appeared on the screen, in living color. In his shirt pocket was a pocket brain; the screen had no computer attached, though there was an old ultravolant discarded in a corner.

Around the walls, leaning in massed ranks behind the sofas, were computer printouts, and paintings. "Always a

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pleasure to have my stuff looked at by a person who appreciates art, Professor," said Sanchez, pulling out a stack of the paintings. "Now, these are most like the things that thief painted; they were mostly done last year. Some of these are computer photoprints—sorry, but the originals were sold."

Morea grunted, turned them to the light, and lined them up, paintings to the left, prints to the right. He glanced at the light. "Daylight fluorescent," said the blond artist tersely.

"Good." Trust artists to have good light if they could afford it. A number of the occupants of the house gathered behind him while Morea silently studied the pictures. This did not trouble him.

The paintings, on illo board, were obviously fantasy book covers, some with visual elements much like those in the one Polk had done, with the addition of dragons and the like nonsense. Clearly Sanchez worked from photos also. They were lower-key than Polk's, darker, but far less subtle. Their foregrounds were cluttered with figures engaged in idiotic physical action. While the backgrounds tended to be loose, even hasty, lacking detail, the heroes and unclad women in the foregrounds were meticulously rendered, but stiff. The poses were awkward and unconvincing, even for frozen motion.

The birds seemed stiff and poised, painfully so when flying by. A butterfly unexpectedly achieved lightness, grace, and the illusion of motion in one painting, but generally Sanchez's living beings seemed stiffer than his stones, and no wind blew in his world.

Morea looked over the non-landscapes with less interest, finding again that the human and animal figures were stiff and awkward, though the composition and layout were all that one could expect in the computer-assisted age. To sum him up in one word, Morea thought: pedestrian.

"Jesus has good technique," someone finally said behind him, tentatively.

Morea didn't respond. He stood up to stretch, and Sanchez brought out a portfolio of sketches and smaller pieces, including some obviously computer-composed, probably pre-pocket brain. One of the women proudly said, "And he sells well to publishers, too."

Sanchez shot her a quelling glance and Morea an uncertain one. But Morea, ogre though he knew himself to be, had no objection to an artist making a living. He doubted that this poor fellow would ever make it in galleries as a fine artist. "With your technique, you must be very popular with publishers of fantasy," he said politely.

"Yes . . . but I'm having trouble with figure work," said Sanchez. "Still, I know good work when I see it, and I know my own problems. That's why I'm not doing so well in galleries. In a few years . . ."

Morea had long known why the ancient prospectors toiled in poverty for so many years, most never finding gold.

"Care for some coffee, sir?" the redhead asked. "A little something to eat? I know it's early, but evening comes early. . . ."

Rita, her name was . . . vagrant memory. Morea still couldn't place her. "Just a cup," he said. "I've another stop tonight, where I won't be so welcome."

Sanchez grunted. "That bastard! I

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can imagine he won't welcome you. 'Borrowed' my brain while my arm was fractured, my ass!"

Distastefully Morea asked, "Did you miss it at the time?"

Sanchez grunted again. "No, matter of fact, I don't use it all the time like lots of guys do. I use it only when painting. It helps me maintain concentration. Using it, I can compose the whole picture in my mind, visualizing the models and moving them around. I can also change their shapes and attitudes mentally; the picture's totally composed and visualized before the paint is mixed. It saves time in composing, in the charcoal stage, and in the actual painting. And the composition itself is much faster; I can do in minutes mentally what would take hours on paper. It also helps guide the brush hand."

An artist using a pocket brain hardly needed models, perhaps at most a few photos. This blond fellow seemed to have been working from old magazines. Computer assisted art, even before the advent of the pocket brain which entered the mind of the user, had been strong in this area, almost sculptural in presentation. Morea repressed a snort of contempt; it was all, in his opinion, style over substance. If art doesn't have *feeling* it isn't art. At best it's illustration—fine in its way—but . . .

Sanchez grinned at him, knowing well enough his opinion.

"Do you have anything you did before you got the pocket brain?" Professor Morea asked irritably, accepting a cup. Someone—probably a confounded pocket brain user—knew just how he liked his coffee.

"That scene of the Battle on Kull's Mountain dates from before the brain," said Sanchez. "And—" he named a couple of others and Morea glanced at them again.

It seemed that the brain wasn't the cause of the stiff mechanical feel to the people and animals in Sanchez's style. In fact, he admitted grudgingly, the brain-assisted paintings seemed freer and livelier than the others.

"So you fractured your arm and couldn't paint, and Polk got hold of the brain?"

"Yeah." Sanchez muttered in Spanish—Morea had once known it and recognized the rhythms, but he'd never learned these terms—and finally said, "We saw quite a lot of each other. He's a professor in the Art Department—I don't know how much you've kept up, since you retired. I'm a part-time instructor, myself. It keeps my hand in, and I need a steady income, even a small one. Freelancing *is* uncertain."

"Yes."

"There aren't so many artists in town, Professor. We form a fairly close-knit community."

"This must have nearly shattered it."

Sanchez threw his arms up in the air and a dark-haired man, who had brought the coffee in, shook his head in disbelief. "Has it ever! Most are against Polk, but there's always been an undertow against pocket brains, and even against computers in general. You should know, Professor; I know your views on the democratization of Art by way of the computer. I suppose you're even more opposed to the pocket brain."

"I am." With difficulty Morea restrained himself. "But that's immaterial. So Polk was in and about your

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house—and I suppose you were in and out of his—and he had this opportunity. I take it there was some rivalry."

Sanchez shrugged. "Only the usual. Okay, I'm a commercial artist. Is commercial art necessarily a stepdaughter? It's as exacting, and often as rewarding, as so-called fine art. One of my paintings may be seen by millions of people—one of Polk's by a few thousand, or a few hundred, or only just a few. But I'm boring you with the obvious. Anyway, we had a long-standing argument—"

"Professor, they weren't on really bad terms before this," said an unattractive young woman whom Morea recognized as a former student. The young man with the coffee pot was attached to her, he supposed. Artists had lived this way when he was young. Morea felt a pang, then shook it off.

"No? Well, that soon changed."

They chatted for a while longer, the artists carefully not asking him how he would testify, and Morea dragged himself away without having committed himself to an opinion of Sanchez's work.

Having taken the precaution of calling ahead, he was met at the apartment house door by a frowning Lindine Polk, a tall fellow with long brown hair, older than Sanchez. Morea smoothed his own long white hair back—the chill wind had gotten frisky in a heavy-footed way—and said, "Mr. Polk? Professor Morea. If you'd care to see the court order—"

Polk was a former student, then an assistant, before Morea retired. His features were normally not pretty, and at the moment were disfigured by a forbidding scowl.

"No, don't bother. Come on in, Professor. I've got my stuff out already. I hope this stupid case doesn't keep you from getting off to Florida."

"Don't worry about that; Florida's boring. Everything's too high-key there for reality."

Polk ushered him in. "Sorry about the light; it's the best I could do. Or would you rather come back tomorrow? I get pretty good northern light here, and of course the skylight's pretty good when it's clean."

"How often do you clean it?" Morea asked, looking at the paintings. Another real artist, though he saw a computer screen and a now old-fashioned ultravolant computer with "artist's" keyboard and twin mice. A color laser printer's cover was off, but it had been used last for printing letters.

"Every month or so."

The paintings were mostly portraits, subtly distorted in a style that Morea was familiar with. He'd seen a number of these in local galleries; Polk enjoyed a minor reputation, not unearned. These portraits were intended to be insidious, at first seeming normal, then somehow off, then opening as windows into the souls of the subjects. For Morea the technique failed as often as it succeeded, but he recognized the serious intent.

Polk produced a kitchen chair, wordlessly placed a pillow on it, and slid it behind Professor Morea, who thanked him absently, scarcely noticing the interruption. No doubt about it, Polk was a better artist than Sanchez.

"How do you like your coffee, sir?"

"Cream, no sugar-substitute."

Polk was a good technician; his works were vivid, lively, believable. Here was

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no stiffness, and his use of color was expressionistic rather than naturalistic. He used the same techniques on the still lifes and landscapes. Here, though, Polk succeeded more frequently, perhaps because his models had no souls to plumb.

In general, Polk's inability to illuminate his human models's natures—or his own—often made his work pointless, ultimately boring.

"So you decided to try out a pocket brain, just to see how it worked, eh?" the Professor said hostilely, returning to the sore point like a tongue to a tooth-cavity. He sipped his now-cooled coffee. To his surprise, he had spent at least half an hour staring at the pictures.

Polk shrugged, defiant despite Morea's minatory tone. "Yeah, why not? Sanchez—he's a good enough guy, but all he'll ever be is an illustrator—he's always talking about the art of the people and all that. Mind you, the kid's not entirely wrong, but any artist worth his salt soon finds he's gone where the people can't follow. What's he supposed to do, spend the rest of his life drawing comics? But I thought, why not, give it a try, try out the damn brain and see how it goes."

"Did it force you to paint in his style?" Morea squinted at him half-superstitiously.

"What? I didn't. That painting's my own."

"Then the brain had nothing to do with it?"

"No. Oh, I see what you're getting at. No, I did some portraits, my usual stuff—just sketches, you know—for warm-up. If you want to see them, I can dig them out."

They turned out to be computer printouts; Polk had gone all the way with the brain. As he said, they were visibly in his style, but to Morea's surprise they were not as pointless as usual with him. Of course, he told himself unhappily, one can't generalize from three sketches . . . yet, there was an undeniable verve, force, and vigor here that echoed the best things of Sanchez's paintings. Perhaps for that reason these sketches seemed to live, to exist, to make a definite statement.

No doubt about it, Morea concluded glumly, he was a far better artist using the goddamned brain than without it.

Correction: using *Sanchez*'s brain, he was a far better artist.

One of the professors at the university whom Morea most respected was Paul Carson. He had known the other vaguely—Carson was in the History Department—but they had become close over the issue of admitting pocket brains into the university. An issue they were on opposite sides of.

"I've already had one rum and coke tonight, Mariam," Professor Morea said to Paul's wife, "but it was weak and that was hours ago, and it's been a *long* night. One, please, and not too weak."

"Drink as much as you like, Allen; we'll drive you home in your own car if necessary." She tossed her mahogany mane back, poured ninety-proof liquid. Mariam had kept her youthful figure and hair color into early middle age; Carson probably had no idea how lucky he was.

"So how bad was your day?" Carson asked.

"I'm glad you asked that." Morea tasted his drink and nodded in approval.

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"Now, that's got authority—and only authority will help me tonight."

"Is the painting Polk's or Sanchez's?" Mariam asked.

Morea looked at them, one and the other. "Both," he said. "And I confess that's the last thing I expected to find out. It has the best parts of both their styles. Mind you, it's far from being a great piece of art. Neither of these two is ever going to burn a path up Mount Olympus, they couldn't make it up Katahdin. Sanchez is making a fairish living doing commercial art, but can't have had many gallery sales. Polk of course teaches, and has had showings from time to time. I've seen him in local galleries. He sells his stuff not infrequently."

"A split between fine art and illustration?" Carson asked.

"It looks like it, but really there's not that much difference between the men, except of pretension. Both are keen as mustard—ambitious, I mean. I suspect art as being secondary to success in their cosmoi."

"Would it be prying to ask how you mean to testify?"

"I'll have to tell the truth," said Morea, shaking his head. "That damned painting in my opinion couldn't have been done by either of them without the aid of the other, one way or another. It's a true collaboration."

"*That's* going to make you unpopular on campus!" said Mariam.

Morea looked at her, surprised. "Well, of course. I'm used to that."

"They certainly could not have chosen a more honest man, or one more willing to speak his mind honestly," said Carson admiringly. "Allen's *always* in some kind of brawl, Mariam. He knows what tact is because he's read about it, but even painful honesty he knows at first-hand."

Morea shrugged in some irritation. "That's what a court-appointed expert witness is supposed to do. Tell me something, Paul—just how can these artists who don't even like each other much, manage to collaborate using a pocket brain? I asked Polk how it felt to be using someone else's—I couldn't see how the brain could work for him—but he sort of tossed it off."

"Why did you think it couldn't work?" said Carson, sounding startled.

"Well, I gather that these brains have to learn their owner's internal mental signals for commands. Once it learned one person's set of signals, how could it respond to someone else's?"

"Oh—easy. See, the built-in program that tells it how to interpret a person's mental signals is still there. When it changes owners, the brain simply 'learns' a new set of command signals. Like learning to ride a bicycle without forgetting how to walk."

Carson pulled out his own pocket brain—he wore it constantly, Morea knew, except when sleeping—and started to unloop the white "fishing-line" of the neuroantenna from around his neck. "Here, try mine and you'll see—"

But Morea shied away and said, "No thanks! I'm too old a dog to learn new tricks. So. I can see, then, how Polk could learn to use the brain—or it learned how to understand him. But how did the brain affect him so as to cause him to pick up Sanchez's tricks?"

Carson looked at his pocket brain for a long time, till Mariam got up to re-

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plenish the ice in their drinks. "Hmmm," he said. "Well, we've always been told that the pocket brain picks up information from the user as well as from normal inputs, that in fact a sizeable portion of your current memories may be unconsciously implanted into the brain. We're warned that much of our mnemobubble capacity may be taken up with extraneous memories unless we debug occasionally, or form a habit of not remembering unless specifically ordered. A careless user, running the risk of clogging his memory, might wind up mapping his personality onto his brain. Very interesting."

"Mapping your personality onto your pocket brain," said Morea sourly. "What's the word for that? — isomorphism?"

"Analogue, perhaps."

"How does this analogue, or isomorph, function in the pocket brain?"

"You know I'm no expert on these things. Hmmm. Probably as a simple program. The thing that made pocket brains possible, more than miniaturization, more than ultavolant speeds, more even than the neuroantenna, is the self-programming programs they are loaded with. It is therefore eminently capable of dealing with a personality-analogue as a program. It would probably only manifest itself in some such way as this."

"Except to the legitimate user, I suppose, and he wouldn't be aware of it." Morea looked at his glass. "Mariam, I'm going to have to accept your generous offer of a ride: bring out the rum."

It was cold, keen, and clear next day. Professor Morea struggled through a light dusting of snow, conscious of the age and fragility of his bones, aware that the stick might slip as easily as he. The police station, normally no haven of refuge, looked positively heavenly when he'd crossed the parking lot, where the snow was packed into ice. At least the air blew away the dregs of his mild hangover.

The desk sergeant was pleased to see him. "Heard the latest, Professor? That guy Sanchez has dropped criminal charges against the other artist. He's gonna sue him."

Morea frowned, taken aback. "No, I hadn't heard. Hmmm. I suppose he'll want an expert witness in any case. What's the nature of the suit?"

"Well, I don't know the details—was just done this morning—but something about Polk not selling that painting."

"Understandable." Sanchez's contention would be that the painting was in some measure his, his style having been stolen via the pocket brain. Polk of course had said bluntly that it was all his, and would hold to that. "I'm going to have another look at it, with your permission," he said.

The sergeant was profanely glad to help. Morea seated himself glumly in the uncomfortable chair, and had a twinge of regret for Polk, who despite his defensive attitude had had the grace to supply him with a pillow.

Damn this painting anyway.

Looking at it again, after having seen the solo works of the two artists simply—and amply—confirmed the conclusions Morea had already come to. This could only be called a collaboration. It partook heavily of the person-

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alities—as revealed in their solo work —of both men.

Morea had had no idea that a pocket brain could do such a thing. He had had the vague idea that they were good for such things as calculations, remembering dates and phone numbers, remembering and recalling vast numbers of facts. It was actually possible to plug in a bubble loaded with a foreign language conversion, and immediately begin to *speak* the language.

The ability to learn an entire subject, such as history or anthropology, and recall the facts, the ability to do so subtle a thing as to speak, without knowledge of it, a foreign language, the enhancement of an artist's ability to visualize in vivid, three-dimensional detail—all these aids to the human mind were fairly obvious and straightforward.

But to map an analogue of one's personality onto the pocket brain—And for another user to experience this isomorphism as if it were the first user's personality in his own head—who could have foreseen such a thing?

What a profound invasion of privacy, thought Morea. No wonder Sanchez is so vindictive. It's more than a simple borrowing, as the desk sergeant felt all along. It's a form of mind-rape; probably the nearest to telepathy the human race will ever come. There'll ultimately have to be laws proclaiming the sanctity of the mind. He shook his head, staring at the damnable painting.

No question about it. It was a true collaboration. So is a child born of rape.

Both men have rights here, but Polk fewer, since he was in the wrong, in using the brain without permission. If he'd acquired permission—I don't suppose Sanchez had any idea of the degree to which he'd mapped himself onto his brain—there might not have been a problem. They could have marketed it as a novelty, a collaboration, and let it go.

Huh. Wonder if Sanchez might not have felt violated, even if it had been with permission, once he found how intimately the pocket brain influenced Polk. No wonder Polk denies the influence.

Yet, maybe not. Maybe, if they'd been good friends to start with, or if they had been aware—as now artists, in all media, must be aware—of the dangers of the pocket brain, they might have done this deliberately. Morea shook his head. He couldn't imagine sharing his personality, even in isomorphic form, that intimately with anyone, but he could imagine others doing it.

It might even begin a new art technique, in many media. Mental collaborations!

Good God! Morea stared aghast at the painting. What had Paul Carson said? The personality-analogue would be treated by the pocket brain like any other program. Why, it would be a simple matter to have it pull the analogue out and store it—or copy it—on a bubble. And pneumobubbles could be duplicated with all their data, by the thousands, millions, for a buck or so apiece.

Paint like Picasso! Blow your horn like Boots Randolph! Write like Wrede!

It would be literally possible to sell your soul—if you were famous—to the multitude. Singers, rock stars, cloning themselves on the hapless followers. My God, think of all the books "in the tradition of" Tolkien. But of all the liv-

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ing artists, writers—oh my God! *Actors*. How *can* they ever acquire characters, personalities of their own, if they can buy those of great actors and actresses for a song? It's hard enough for them now.

It looked like hell for the human race. Especially when the kids started putting on and taking off the personas of older people. A bleak succession of mindless people filling their lives with the living of other people, experiencing life through other eyes, not trusting their own.

They'd surrender the very castles of their own individualities to the invasion of the personalities around them. The battle that culture had fought for so many generations would be lost overnight.

What else was art for, but to arm the individual against this kind of invasion, by showing the value of each person's own unique world-view? And now, all lost! In his anger and despair Morea lashed out blindly, felt the shock in his ankle and leg, and heard the rending thump of canvas.

He'd kicked a hole right through the picture.

After a long moment he looked over his shoulder. The door was closed. No outraged policemen burst through to accuse him. Still, they were in and out, and would soon know what he'd done.

Morea dithered, gasping for breath. Contempt of court if nothing else.

Then he thought: at least this painting isn't going to be sold. Sanchez would like that, and Polk—well, the uproar might have caused him to have second thoughts. Of course Morea might be in trouble, even if they didn't protest.

If it had been an accident—? He hadn't a lot of time, but a fall—putting his knee through it—

Professor Morea stood, lifted the ruined painting, positioned it, then hesitated. This was going to hurt like hell. After a moment his courage returned and he let himself fall forward on one knee onto the painting.

It did hurt like hell. He knelt, gripping his cane, feeling the explosion of pain in his knee begin to fade, felt it throb with each heartbeat. *Touch of arthritis, maybe?* He had had no idea it would hurt so much. He wasn't, in fact, going to be able to stand without his cane, and gripped it fiercely.

But for now he had done all he could do, and merely knelt in agony, mental and physical, shedding a hot tear, and another, with a whimper rising in his throat for the pain, and for the future, for all the people who would never now be born as self-conscious individuals . . . . ■

●Utopias now appear much more realizable than one used to think. We are now faced with a very different new worry: How to prevent their realization!

Nicholas Berdiaeff

submitted by G. Harry Stine

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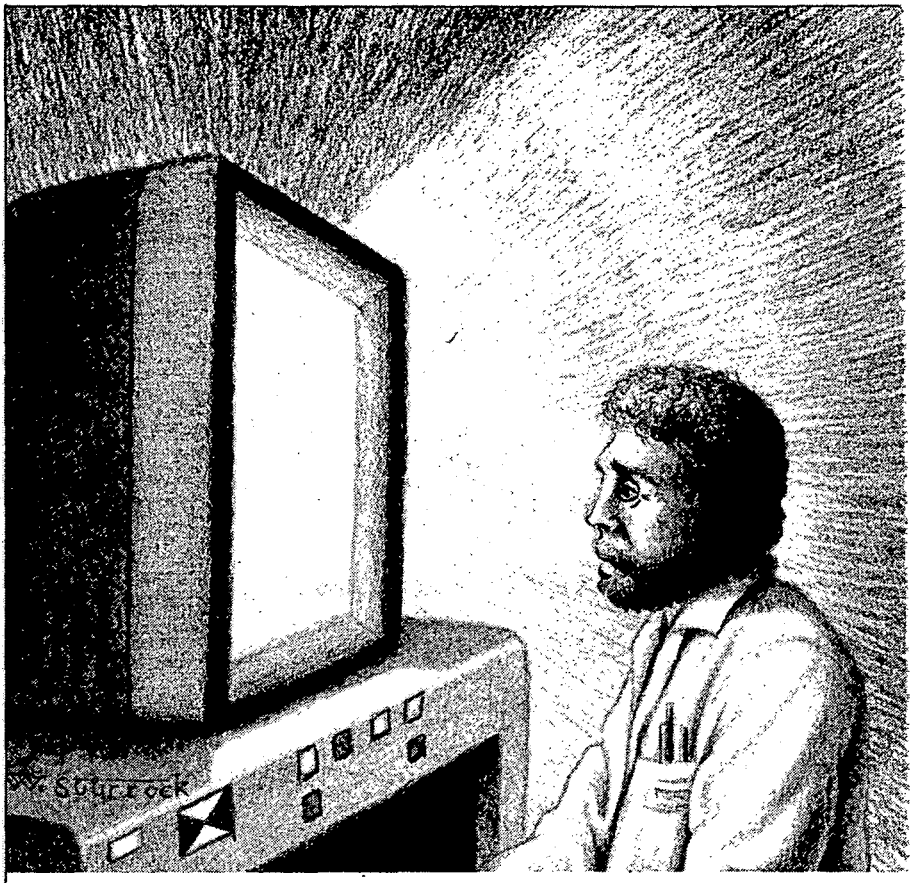

Walt Sturrock

W.R. Thompson

ORACLE

What good is a fortune-teller if
many futures are equally possible?

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Know your audience, Jim Hook told himself, as he led the Institute's three guests into the lab. Within the next few minutes he would have to convince the trio that the lab had found a way to view future events. That would be tricky work, but he could do it. Jim already knew what his visitors wanted to hear . . . and he knew that they wanted to believe he could predict the future.

Two of the visitors belonged to the President's "kitchen Cabinet": the unofficial group of advisors who helped him set his policies and make decisions. They weren't scientists, which complicated things; they would lose interest if they thought Jim was snowing them with jargon, and they would take offense if they decided he was talking down to them. Jim would have to walk a fine line as he explained things to them—and he would have to make cer-

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tain that his third guest, their secretary, also understood everything. Jim had long since learned that you ignore a secretary at your own risk.

"Originally, we designed this system to look for tachyons," Jim told the group, as they looked at the equipment which cluttered the lab. "We're still not certain if we've found them, or if we've stumbled onto a related type of particle. Our mathematical models are still vague on that point.

"Until things clear up, we've chosen to call our new particles *chronons*. We know that they have negative energy, negative or imaginary mass and dimensions, travel faster than the speed of light—and move backwards in time. Basically, our detectors pick them up; the computer sorts them out, analyzes them, and uses them to generate a video image of a single moment of the future."

"Hmph. Sounds like a TV," Dash said. The financier peered at the lab's Digidyne-3. "But why do you need such a heavy-duty computer? Expensive, isn't it?"

"It is," Jim agreed, although he knew that Dash wasn't concerned with the costs. Movie production companies used Digidynes to animate special-effects scenes, and a Digidyne-3 could just as handily simulate "future" events. Fortunately, Jim thought, Dash was about to suggest a foolproof test of the system.

"I understand that your machine has some strict limits on its use," Chose rumbled. The stockbroker looked ill at ease in the presence of the electronic oracle. "It can only see a month or so into the future, and it can only see events which happen within a few miles of it."

"And we can't always get a crystal-clear image," Jim agreed. Then, because they expected a plea for funding, he added, "With enough research and development, I'm sure we can stretch the limits a little—"

"But you *can* see within those limits," Dash said, checking his watch. "Now, my partner is the most regular man on Earth. Every day at noon he leaves our office and goes to lunch. Why don't you let us watch him leave the office? He'll do it in less than an hour."

"All right." Jim sat down at the computer, smiling at Dash's deliberate misdirection. "The most regular man on Earth" was a woman. Dash knew that no oracle worth its salt would fall for such a trick—and Jim had prepared for it. He entered a brief command. "There."

The visitors looked over his shoulder at the terminal's high-resolution screen. The frozen image showed a typical Washington office building, with a mailbox in the foreground and a newspaper rack near the lobby. The image was a bit hazy, but still clear enough to reveal the headlines on the *Washington Post*. Several people stood in the picture, including a businesswoman with iron-gray hair. "There's your partner," Jim told Dash. "Mrs. Watchett, isn't it?"

"That's her," Dash agreed reluctantly.

"Charley," Chose said, "It didn't take him any time at all to find your office—or to spot Mrs. Watchett."

"I did a little research last night," Jim said, patting the computer. "That's

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when I fed in the coordinates for your office. Quite a timesaver, this gadget."

"You *knew* about this?" Chose asked. "Everything?"

Jim gave Ms. Blank, the secretary, a sly look. "Everything."

"Very well," Chose said uneasily. He clearly disliked the idea that he could be watched by an unseen—and unseeable—observer in the past. "Doctor, either you've hired some impossibly clever detectives, or you can do what you claim."

"The smart money is on the detectives," Dash said, turning to Jim. "Doctor, you *did* say that we could examine your software. Ms. Blank?" Dash nodded to his secretary, who took Jim's place at the computer. She set to work with quiet efficiency.

"When I first heard about your time-viewer," Dash continued, "I found myself recalling the stories about the ancient oracle at Delphi, in Greece. This oracle was merely somebody who had hallucinations—'visions' which had to be interpreted for the credulous by a well-paid priesthood." He graced Jim with a sardonic smile. "The oracle gave good advice, though. You see, the priests always investigated their visitors beforehand—"

"I know the story," Jim said. "Before they visited the oracle, the supplicants usually stopped off at a hostel near the temple. While they were there, somebody would get them to talk about the reason for their pilgrimage to Delphi. Then a messenger would sneak away and give this information to the priests, who could use it to prepare a suitable prophecy. The supplicants never knew they'd been spied upon."

"Er, no," Chose said uncomfortably, and changed the subject. "See here, doctor, doesn't your time-viewer violate cause-and-effect?"

"It only seems to," Jim said. "You're thinking about paradoxes and self-fulfilling prophecies, aren't you?"

"*I* sure am," Dash said. "Let's imagine that your machine could show me, say, the plans for an anti-gravity device—something we don't have, and that could only be invented after lots of research. Now, I could take those plans and build the machine . . . which means that there'd be no need for the research which built the device, so how could it be invented in the first place?"

Jim smiled thinly. He had to divert the conversation from that topic. "The truth is, we've tried our damnedest to create paradoxes, but we've always failed. A paradox may be a misconception, a product of our limited understanding of the universe. There are theoretical reasons to think that a paradox is impossible, but I can't explain them as simply as I'd like—"

"Try," Dash suggested, in a voice which said *he* was in charge here.

"Okay. First, our system works by detecting chronons, which are produced in quantum events. A quantum event is something which happens at the nuclear level—for example, the disintegration of a radioactive nucleus—and which has only two possible results. You can see that a radioactive atom either *will*, or *will not*, decay, correct? An everyday analogy of a quantum event—" Jim fished a coin from his pocket, tossed it and caught it. "Heads or tails, gentlemen?"

Chose laughed. "Tails," he an-

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nounced, looking at the quarter.

"Right. Now, imagine that a radioactive atom decides whether or not it'll disintegrate by tossing a coin. Heads, it falls apart, tails, it stays in one piece." Jim tossed the coin again, caught it and covered it. "How did it land?"

"There's no way to tell without looking," Dash said in annoyance.

"Exactly, but you'd say it definitely came up heads *or* tails, right?"

Chose shrugged. "That's just plain common sense."

"That's *everyday* common sense," Jim corrected him. "But the common sense of quantum mechanics says that, until you've actually seen the results, you have to assume that it came up both heads *and* tails."

"That's impossible," Chose said.

"In a way. What actually happens is that at the moment of decision, Time splits into two branches. These branches are identical, except that in one of them the coin landed heads up, and in the other in landed tails up." Jim uncovered the coin. "We're in the universe where it came up heads. That means there's now a parallel time where it landed tails up."

"I suppose that has something to do with the uncertainty principle." Dash mused.

"Yes, it does," Jim answered slowly. How much does he know? Jim wondered. Was that a lucky guess, or did Dash understand the basics of quantum mechanics? Was he a hobbyist, with a dilettante's knowledge, or had somebody carefully instructed him? That detail could change the outcome of this meeting, and there was more at stake than next year's budget.

"Heisenberg's uncertainty principle," Jim pressed on, "Is a fact of life in physics. At the nuclear level, where quantum mechanics functions, there's a certain amount of—well, *fuzziness* built into the universe. It turns out that it's impossible to know a particle's position and energy with total precision, which means that it's impossible to predict exactly what will happen to an atom, or a tossed coin—"

"—or a horse race, or an election," Dash concluded. He took off his glasses and made a show of polishing them with his handkerchief. "What you're claiming is that two duplicate universes form, with two earths, two suns, two galaxies, two of everything—because not even the universe knows how any event will turn out, and it has to accomodate all the possibilities."

"That's about the size of it," Jim said.

Chose sputtered. "But—there must be millions of these quantum events every second. Billions!"

Dash nodded. "At the very least—*if* the theory is right." He gave Jim a look which he must have learned from an ill-tempered judge. "This notion of parallel time is an old one. O. Henry used it in a story a long time ago. The theory may even be true; I've kept my mind open about physics ever since Hiroshima. But there *is* one thing I don't understand. If you start out with one universe and end up with two, where does the extra matter and energy come from? Aren't you creating something out of nothing? I thought you physicists had conservation laws to prohibit that sort of thing."

"The conservation laws don't pro-

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hibit it; they *regulate* it." Jim felt a sense of relief. Whatever Dash knew, it wouldn't keep him from accepting what he saw here. In fact, it might even make it harder for him to deny things—which he would want to do after he left. "You're correct when you say we can't create something out of nothing. However, the conservation laws only say that we have to end up with what we began with—"

"Wait a minute," Chose said. "What are these 'laws'?"

"They're book-balancing things," Dash told his companion. "Atomic particles have all sorts of properties—charge, spin, mass-energy, and so forth—which have to be kept track of. You can't start out with, say, one positive charge, and end up with two positive charges . . . which is the sort of thing that's happening here."

"That's a good point," Jim said. "But the universe *does* permit bookkeeping tricks, as long as the books balance in the end. Take a quantum event where an atom may or may not decay. At the instant of decision, *three* particles are created: one undecayed atom, one shattered atom, and one chronon. The chronon is a complete negation of one of those two other atoms—"

"Like anti-matter?" Chose looked dubious.

"Yes, and no," Jim said. "I suppose you know that every normal particle has an anti-matter counterpart. There're protons and anti-protons, electrons and positrons, and so on. Put them together and you get a violent reaction that ends in pure energy.

"Now, every normal particle also has a chronon counterpart. A chronon completely cancels out one of its counterparts . . . like a pile of dirt, and the hole you dug it out of. Put them back together and you wind up with nothing.

"That's part of the reason our chronon has to travel backward in time: it balances out the existence and temporal momentum of a forward-moving particle. Another reason is that the chronon has to signal the universe to split into two timelines—"

"You mean *three* timelines," Dash said. "You have two universes going into the future, and a third universe, composed of chronons, flying into the past and canceling out one of the two normal universes. An interesting notion, that."

"You've got it," Jim said. "The two universes have to split in an instant, so

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the signal to split has to travel faster than light-speed—at infinite speed, in fact. Traveling faster than light means that you inevitably travel backwards in time; that's the way the laws of nature are set up. The only possible conclusion here is that you can send information backward in time."

"And because of this signal, each particle in the universe gives off a chronon," Dash said, in a voice heavy with skepticism. "So you create a—a ghost universe, an image, each time there's a split in the timelines. But that won't tell you how the decision comes out."

"But it can tell you something about the decisions which preceded it, and how *they* came out," Jim said.

"Ahhh . . . "

"I don't like this," Chose said suddenly "See here, Hook—you're telling us that every time we make a decision, we actually go both ways on it? Yes and no, come and go? If we don't really 'decide' anything, doesn't that make life futile? What happens to our free will?"

Jim averted his face to hide his expression. By chance, he found himself looking at the secretary. She was quaking with barely-restrained laughter, and Jim knew that she appreciated the joke. Chose had come here to *escape* the burdens of free will.

Jim managed to hold back a contemptuous laugh. "We can't put free will into an equation, and we can't formulate intelligence—but we have run experiments in that direction." He gestured at a lab bench. "We had a fellow sit down there with a .45 pistol, and we told him to think about committing suicide. You'll have to agree that he either would, or would not, shoot himself—but he didn't, not on any timeline we examined."

"You might not have looked hard enough," Chose said.

"We looked. Our computer can examine tens of thousands of alternate timelines every second. We should have found one timeline where our subject killed himself, for whatever reason, but we didn't."

"Maybe he had no reason to waste himself," Dash said.

"That's the key," Jim said. "It only *appeared* that he had to make a decision. He wasn't even remotely suicidal, so despite our suggestion, he had nothing to decide. You see, a choice which involves intelligence isn't the same as a random decision, like a coin-toss or radioactive decay. Intelligence limits your options, by letting you avoid the choices you think are wrong.

"Look at it this way," Jim said, seeing the baffled looks on their faces. "If a monkey sits down at a typewriter and bangs away at the keys, it'll produce every possible combination of letters. After a few trillion years it will, by sheer chance, produce 'Hamlet.' But if *Shakespeare* sat down at that typewriter, he wouldn't produce reams of gibberish. He'd turn out fine, coherent stories."

"If you say so," Dash said petulantly, "But I always thought Shakespeare was gibberish in the first place."

Jim smiled. "Well, then, if somebody offered you a ticket to a Shakespearean play, would you really have to decide whether or not you wanted to go? I'd call it a foregone conclusion."

"So there is free will?" Chose asked, sounding hopeful.

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"Whatever 'free will' is," Jim said. Chose's concern, paradoxical though it was, had a good point, Jim reflected. It meant that the man took this business seriously; he was almost convinced that there were such things as chronons and parallel times, and that the time-viewer could work. "I think that our personalities make the results of some 'decisions' inevitable. Would Florence Nightingale have murdered a patient? Would Nixon ever have told the truth? Would you do something that went completely against your grain?"

"Good enough," Chose said, while Dash nodded thoughtfully. That satisfied Jim; it was vital that they come out of this event with the belief that there was nothing futile about making decisions.

"Philosophy is all very nice," Dash said at last, in a tone which said it wasn't, "But we're not here to unravel the whichness of the what. Hook, I'm almost convinced that your oracle can predict the future. At least, your theory holds together . . . but it's still just a theory—"

"So is the theory of gravitation," Jim said hotly. "A theory is just an attempt to describe how something works. If you manage to disprove the latest theory of gravitation, that doesn't mean it's suddenly safe to step off a cliff."

"*Touché,*" Dash conceded. "But I can *see* gravity at work. Your viewer is an unknown, and it might be, er, that is—"

"—a fake?" Jim asked. He turned to the secretary. "How about it?"

"I can't find any special-effects programs," Ms. Blank told the men, "Or any pre-recorded scenes, or blocked programs, or anything else. The entire system is clean."

"Then it's time for a real demonstration," Dash announced. "Let's have it, Hook."

"I'll have to give you several previews," Jim said, sitting down at the terminal. "You see, as time goes by and the decision-points multiply, the timelines diverge more and more—"

"Yes, yes," Chose said impatiently. "You're going to show us alternate futures. That's clear. Get on with it."

"All right." Jim punched some commands into the system and pushed his chair back. "Here comes the first run."

"That's my office again," Dash said, as the first image appeared.

"It's a good choice," Jim said, tapping the screen. "This newsstand will let us follow events. There's a possible headline from tomorrow." STORM HITS FLORIDA, the *Post* declared. The scene changed, and the next day's headline read CHINA SUMMIT SET FOR DECEMBER, DEFENSE PACT HINTED.

"That's supposed to be secret," Chose said quietly. "Charley, if he's using detectives, I hope he lets the CIA hire them. The Company could use them."

"It was just a hope," Dash growled. "I'm still not sure I believe this." Nevertheless he didn't look away from the screen. ANGELS WIN SERIES. NEW TAX CUTS UNVEILED. SOUTH AFRICANS FREE PRISONERS. STOCK MARKET SETS NEW RECORD. DYSON DECLARES CANDIDACY. POLICE SMASH DOPE SMUGGLING RING. DEFICIT CEILING RAISED AGAIN. The scene jerked like a crude time-lapse movie. Several

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times the screen caught Dash and Chose standing in front of the newsstand, gazing at the rack as if it had—or would—become a shrine. As time passed, the future images became less distinct. The last pictures were shapeless grey blurs.

"Ready for the next series?" Jim asked, after the screen went blank.

"Yes . . . yes," Chose murmured. Dash nodded in silence, an odd smile playing across his face. He had seen the future, or at least a month's worth of it, and he had found himself in it—alive and well. That was more convincing than any argument over philosophy, and far better than any talisman. Dash was caught by the same lure which compels even the most skeptical mind to read a newspaper's astrology column.

He believed.

"This round will look different," Jim said, entering new commands into the computer. "The effects of even tiny changes multiply rapidly."

"That's why we're here," Chose said cheerfully. "We'd like to see the results—especially the unexpected ones—of our decisions. I can't imagine a better way to keep out of hot water. Think-tank reports and computer projections are always so vague, you know. They always leave you up in the air."

"I see," Jim said. He tapped an extra command into the Digidyne, ordering it to seek out and display one special sort of timeline. Then the next series of images began.

STORM HITS FLORIDA. CHINA SUMMIT SET FOR DECEMBER, DEFENSE PACT HINTED. DODGERS WIN SERIES ("So much for making any bets," Dash joshed). NEW TAX CUTS ANNOUNCED. SOUTH AFRICANS RELEASE MORE PRISONERS. SOVIETS DENOUNCE CHINA SUMMIT, DEMAND CANCELLATION.

Jim watched Dash and Chose exchange surprised glances. "Why would they do that?" Chose asked.

"Search me," Dash said. "They always have been paranoid about the Chinese, though."

DYSON DECLARES CANDIDACY. PRESIDENT REFUSES TO CANCEL SUMMIT. DEFICIT CEILING RAISED AGAIN. SOVIETS WALK OUT OF U.N. NASA LOFTS SPACE STATION CORE. SOVIETS CROSS BORDER INTO WEST GERMANY. NATO FORCES STILL FALLING BACK. SOVIETS DENY MAKING FIRST USE OF NUKES. NO NEED TO EVACUATE AMERICAN CITIES, PRESIDENT ASSURES NATION.

In the next image, the lobby windows were shattered, the mailbox was smashed flat, and only shadows marked where people and the newsrack had stood. The image changed once more after that; the marble facing of the building had become cracked and partly melted. The scene remained that way until the image faded into a grey haze.

"That's only *one* possibility," Jim said into the silence. He sounded like an embarrassed parent with a naughty child. "The odds against that timeline happening are—"

"—enormous," Dash croaked. "But it *could* happen. It *did* happen, on that timeline."

"But it was a low probability timeline," Jim said briskly. "It's a product of many unlikely, and bad, decisions.

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I've seen dozens of lines like that one, but on the whole they're very rare—"

"Hate to count on that," Chose mumbled.

"What you need," Jim said, typing some new commands into the terminal, "Is to see another timeline, one with a happy ending—"

"Not now," Chose said hoarsely. "Look, maybe we can finish this some other time. We'll make an appointment, or something."

"Of course. It's easy for me to forget how unsettling this can be." Jim made soothing, banal noises as he ushered Dash and Chose out of the Institute. They wouldn't return, he knew. His guests never came back for a second show. Jim would have been worried if any of them *had* wanted an encore.

Jim went to the nearest coffee machine, and killed some time with a cup of hot, bitter gunk. He realized that he might never know how well this meeting had turned out, but that didn't matter. Dash and Chose had been forced to face a few unpleasant realities. One of those was the fact that they couldn't count on escaping the consequences of their mistakes . . . and the other, subtler reality was the fact that they had the power to avoid making some mistakes—if they were willing to use that power.

After a while Jim checked his watch, and decided that it was almost time to return to the lab. While he had been bidding farewell to Dash and Chose, their secretary had remained in the lab. At the moment, Jim reflected, she would be occupied with making copies of the Digidyne's software; her employers—who were neither Dash nor Chose, but one of the intelligence agencies—would want to run more extensive tests for non-existent secrets. If they decided that the time-viewer wasn't everything Jim claimed it was, the revelation would undo all the good he had accomplished. Now the trick was to convince Blank that the oracle was genuine—

—but that it was only a laboratory curiousity, unsuited for use in the real world. It didn't take much imagination to see how a time-viewer could revolutionize espionage and warfare, and Jim wasn't about to see his brainchild become a military toy.

The way to destroy official interest in the time-viewer, Jim had realized, was to make it look as if it still needed a lot of expensive, problematical development . . . and as if he was eager to become the boondoggler in charge of things. Despite the government's reputation for wasting money, that seemed the best way for a scientist to see his work filed and forgotten. Jim had developed an act which had that effect, and so far it had always worked.

But not this time. Jim returned to the lab to find the terminal dark and abandoned. Blank sat in the lab's least uncomfortable chair, leafing through an old copy of *Nature*. "You took your own sweet time coming back," she said, looking up from her reading.

"Ah . . . heh," Jim said. "You've, ah, finished copying the software, then?"

"No. I decided not to. I don't want to play your game."

" 'Game'?"

She set the journal aside. "Hook, I'm not one of those low-level operatives you've bamboozled before. Now I've already verified that your computer is

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honest—there's no fooling *me*. I'm no physicist, but your explanation of the physics of time-snooping checks out. The Firm knows that you haven't hired any detectives, or received outside information from anyone. You truly do look into the future—but you've omitted just enough from your explanation to turn what you've said into a slick, clever lie."

I'll have to be careful, Jim thought, if I'm going to save this situation. "What did I leave out?"

"Understanding. You've created the impression that you have a crystal ball—that you foresaw everything that would happen here today, including what Dash and Chose would want to see, and what *I* am doing here. I imagine that you came back here to reinforce that impression. The truth is that you've been running a bluff."

Jim nodded heavily, and hoped that Blank found him properly abashed. "It's more experience than bluff, though. I've had over a score of visitors like Dash and Chose. They always want the same precise thing; I guess that big egos always run along the same lines. I do my 'spying' with the phone book, a map, and a copy of *Who's Who*."

"And some astute deductions," the woman said. She nodded for him to continue.

"Of course. There's no reason for any of my guests to bring along a secretary, so when one does come along—well, the only question is whether she's an agent for the FBI, CIA, or some other agency. I don't need an oracle to foretell the obvious." He sighed. "I suppose that the priests at Delphi had the same experience. Day after day, people brought them the same questions, the same problems, all requiring the same answers. Those priests must've reached the point where they could give their prophecies in their sleep."

"Perhaps. Your oracle, now—it can't 'predict' anything, can it? That's why you changed the subject when Dash asked about paradoxes. If a decision can go both ways, then foreseeing the results tells you nothing, because you don't know if anyone will ever wind up making that particular decision. You know that a coin has to land heads or tails, but you don't know when or if it'll get tossed."

"That's true," Jim said, wishing that he could stall for time. Blank was interested in doing something other than uncovering his deceptions, and he needed to figure that out. "The only way to create a paradox is to send valid information into the past—but all of our previews are equally valid, even when they contradict one another. In effect they cancel out, and the overall results is that no valid information is transmitted."

Blank nodded. "I thought so, but that isn't too important. I want to know the point of your little charade." When Jim hesitated, she went on impatiently, "Hook, my agency is *most* displeased with you. In the past year you've had visits from some important people, people who play key roles in our government. We've noticed that when they leave this Institute, their behavior is changed. Disturbed. Something you do here upsets them."

"I should hope so!"

"And I should hope you have a good explanation for it—something a little nobler than augmenting your budget."

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Frowning thoughtfully, Jim sat down. "Ms. Blank, do you know how many nuclear crises there've been in the past year?"

"I'm not at liberty to discuss that," she said crossly.

Jim snorted. "The correct answer is 'too many.' In the past year I've seen atom wars—and worse—on dozens of alternate timelines."

"*Alternate* timelines," she said, "*not* ours."

"Ms. Blank, *we* are somebody's alternate timeline. One of these days *we* could be the ones blown to hell and gone by somebody making the wrong decision. In fact—" Jim gestured at the terminal screen "—in a few weeks, that *will* happen to us in one of our futures."

"Okay, I can see that . . . but what's the point in scaring the pants off your visitors?"

"As you said, they play key roles in our government. The President respects their advice. If they ever get into a position to advise him about starting a nuclear war, I want to make jolly sure they advise him against it."

Her face darkened. "Hook, what gives *you* the right to interfere like that?"

" 'Right'? D'you want my speech about a citizen's right to a say in how his government runs the world, or do you want the truth?"

"Speeches are a dime a dozen in this town. The truth would make a nice change."

"The truth is that I'm scared," Jim told her. "I'm scared of dying, I'm scared of seeing other people die, and I'm scared of seeing civilization wiped out. I'm scared that men like Dash and Chose won't do enough to prevent all that. They have the power, but they don't care enough to do anything."

"They do well enough."

"Do they? You heard Chose griping about think-tanks and computers. He came here looking for an oracle, something that could make his decisions for him. He won't make them himself, if he can help it, because he's forgotten why he should make decisions. To him, they're a menace to his position."

"I don't follow you, Hook."

Jim shook his head wearily. "You've seen men like him before. When he makes a decision, he doesn't ask himself if it's the right thing to do, or what it might accomplish, or what it might cost other people. No, he worries about the harm it could do to his own career, if he's made a mistaken choice. In a way he's paralyzed, because his self-concern keeps him from doing anything that might get him into trouble.

"I can't change that, but I can exploit it. I can force folks like that to see the consequences of the mistake that counts: war. Dash and Chose saw themselves on that Armageddon timeline, and that gives them a powerful incentive to keep war from breaking out . . . and I think it shows them the futility of avoiding their responsibilities."

"It's a powerful demonstration that you give," Blank said. "But what good is it? Suppose they *do* help the President to decide against starting a war. Won't that just create a timetrack where the choice went the other way?"

"No," Jim told her, a sudden intensity in his voice. "Weren't you listening when I told them about our suicide experiment? It was genuine. We set it up

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precisely because it has a dramatic impact. It proves that intelligence limits your options. If you know that you don't have to accept a stupid, dangerous choice, then you *won't*.

"That's one reason I'm so willing to play the part of an oracle," Jim went on. "The universe isn't a futile place and we can make a difference in it."

"I see." Her face was an unreadable mask, but Jim could guess her thoughts: here's another naive scientist, interfering with things he doesn't understand, out of his depth and easily manipulated. "So you've been trying to prevent war. I don't know that I like your technique, but it certainly is effective, not to mention original."

"It's not original. The priests of Delphi used their position to influence the decisions some of their supplicants made." Jim scratched his chin. "I wonder how many of the ancient Greeks refused to take sensible advice unless it was wrapped up as 'divine revelation'? Cynical as it may sound, I've been doing the same thing with *my* oracle's gibberish. Many people find it easier to take advice when it has a 'scientific' aura."

"Cynicism doesn't bother me," she said. "I'm concerned with results. Your oracle—"

"My ploy is working," Jim said. "The number of Armageddon timelines is decreasing, so I've had some impact. This may not be the best way to handle things—I wish I could show this to the Russians!—but at least I'm trying my best."

"I'll say this isn't the best way," Blank said pensively. She stared at the floor for a moment. Then: "Doctor, have you ever thought that other people should see your time-viewer in operation?"

"Such as intelligence agents?"

Blank shook her head. "No. Frankly, it would take an enormous amount of work to turn your time-viewer into a practical espionage tool—*if* it could be done. My superiors aren't convinced that's possible, and they're not willing to sponsor an enormous project. However, Doctor, your machine *can* make an important contribution to national security—"

"Here it comes," Jim muttered sourly.

"I wish I knew why civilians are always so suspicious of spies," Blank said in irritation. "Doctor, tell me something. Have any of your visitors ever been unmoved by what you've shown them?"

"Are you *kidding?*" Jim demanded. "Some of them have fainted when they've realized what they were watching. You'd never believe that blurry pictures on a TV screen could be so scary. I don't know what kind of person could watch a nuclear war without feeling horrified.

Her voice turned bleak. "*I* know what kind, Doctor. I know people who can talk about a nuclear holocaust the way you'd talk about—about—" Blank shook her head. "There are too many people like that in our government. Maybe some of them are putting up a false front with that kind of talk, but some of them mean every word they say about surviving and winning a nuclear war. They're not the kind of people who'd visit your oracle; they wouldn't let anything change their minds, no matter what.

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"And that's why the Firm is interested in your machine. We can use it to separate the sheep from the goats. I'm sure that most people would come to their senses after seeing a real nuclear war . . . and we could find out just which people are insane enough, or irresponsible enough, to think of nuclear war as a rational choice."

Jim felt puzzled. "Why would that matter to an intelligence agency?"

"We're a *security* agency," Blank said patiently. "We're responsible for national security—and this nation can't be secure as long as even one maniac can put a finger on the Button. We've done our best to ease them out of power when we can spot them: revoke their security clearances, transfer them to less sensitive positions, push them to retirement—"

Jim cleared his throat. "Anything more, uh, drastic?"

"I hate to disappoint you, but we don't do assassinations. They can backfire too easily—that's how martyrs are made." Blank shook her head. "Anyway, your machine can neutralize a lot of trouble before it happens. It can give a lot of people a gut feeling for nuclear destruction, and—tell me, how would somebody like Dash or Chose feel about the sort of loon who could take Armageddon in stride?"

"They'd never trust someone like that," Jim said. "Not after what they've just seen. I know *I* wouldn't."

Blank nodded happily. "That makes your time-viewer the ideal answer to my agency's biggest problem. The only question is, will you help us?"

Jim thumped down onto a seat. Dealing with an intelligence agency struck him as akin to dealing with the Devil . . . and he couldn't guess at the full impact the time-viewer would have on society. For the moment it was only an expensive, complicated apparatus—but all inventions started out that way. What would happen to warfare and espionage, not to mention private life, when the ultimate snooper became available? There might never again be any privacy.

And yet, Ms. Blank was offering him the chance to continue his work, and to accomplish much more than he could by himself. After a year of watching one future holocaust after another, his conscience wouldn't let him turn down this opportunity.

"I'm with you," Jim said. "All the way. But—don't fool yourself into thinking that the oracle is the perfect answer to our problem. History is full of wonderful answers that created more problems than they solved."

"Like the atomic bomb," Blank said. "I know. Even if it never becomes common or practical, your time-viewer is going to raise a lot of problems. But can you name one invention, or even one new idea, that hasn't caused some sort of trouble? That's the nature of things and nothing will change that."

"Maybe that's right," Jim said. He found himself smiling. "Okay. If we can't get rid of problems once and for all, maybe we can trade the ones we have for a better set of problems." ■

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the reference library

By Tom Easton

The Genesis Quest, Donald Moffitt, Ballantine/Del Rey, $3.50, 320 pp.
Second Genesis, Donald Moffitt, Ballantine/Del Rey, $3.50, 336 pp.
Aiki, John Gilbert, Donald I. Fine, Inc., $17.95, 286 pp.
Star of Gypsies, Robert Silverberg, Donald I. Fine, Inc., $18.95, 397 pp.
The Wardove, L. Neil Smith, Berkley, $2.95, 223 pp.
A Matter of Metalaw, Lee Correy, DAW, $2.95, 256 pp.
In the Ice King's Palace, A. Orr, Bluejay, $15.95, 224 pp.
More Adventures of Samurai Cat, Mark E. Rogers, TOR, $9.95, 127 pp.
Blood River Down, Lionell Fenn, TOR, $2.95, 310 pp.
To the Resurrection Station, Eleanor Arnason, Avon, $3.50, 276 pp.
Futuredays, Isaac Asimov, Henry Holt, $12.95, 96 pp.
Tales from the Spaceport Bar, George H. Scithers and Darrell Schweitzer, eds., Avon, $3.50, 235 pp.

Don Moffitt lives in a small, antique house on a dirt road in the Maine woods, not very far from where I live. Look at his home and its furnishings, and—if you know the man is a writer—you must envision a scholar of the past, a historian or a folklorist or perhaps a poet. You would *never* dream that his mind wanders 75 million years into the future and roams to distant galaxies. Yet, though Don has indeed written historical sagas *à la* John Jakes, he is an escapee from the Big City and his mind holds as much scope and sweep and sense of wonder as any fan could wish.

Witness: **The Genesis Quest** and **Second Genesis.** The first begins in a galaxy thirty-seven million light years away, where the Nar, sentients that roughly resemble doubled starfish and enjoy multiplex tactile communication via the cilia that line their arms, have received a powerful radio message from

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humanity. There is history, art, science, technology, and the DNA code for human beings. Grateful for the technological boost the message gives them, the Nar translate the DNA code into actual humans, and our species is reborn, long, long after its apparent extinction. Sadly, humans are short-lived mayflies beside the Nar and their speech is much more limited than the Nar's tactile Great Language. They are treasured, but they are intellectual cripples, and they know it. In response, some invent politics and terrorism and assert human supremacy by trying to seize a world of their own.

Our Hero is Bram, at first a mere child growing up among the Nar and yearning to return to the home worlds of the Original Humans. He surrenders his dream of becoming an astronomer to become a bioengineer, under the tutelage of his Nar foster parent, and he learns that the original human message held a codicil with the recipe for human immortality. The Nar had not implemented the recipe because they did not recognize its value to humans—mortality is essential to them, for only with age and death can they reproduce.

Bram's discovery helps to save the day when the Nar crush the rebels. It arouses Nar empathy, and they convert their own plans to send a robot ramjet into the heart of their galaxy, broadcasting their own genetic code, to human purposes. The ramjet becomes the tow for a Nar spaceship—a giant space-going tree—that will sweep through the hydrogen clouds near the galactic core, attain relativistic velocities, and carry some humans back to the Milky Way.

Don lapses into triteness only with his rebels—all basements, bullies, and bombs. But the triteness fits, and he overcomes it magnificently. The Nar racial conclave that decides the human fate and the passage of Bram and his crew through the galactic core are surpassingly moving, the one for its pervasive air of pain and destiny, the second because what the humans find in the galactic core is of immense significance to the Nar and gives the humans even more of a sense of mission than they had to begin with.

In **Second Genesis,** we learn why humans died out: The galaxy itself is the Grim Reaper, with immense magnetic scythe blades sweeping through space to cause the periodic mass extinctions of history. The point comes home when Bram and his fellows find the source of their ancestral radio beacon, a sun surrounded by vast energy-collecting discs whose rims bear the ruins of a grand civilization. Here they find ruins, and in them their heritage, a vaster wealth of art and information than was ever broadcast to the Nar. They also find spacesuit footprints in the dust, overlaid by naked animal tracks. The latter prove to belong to the Cuddlies, small creatures adapted to intermittent vacuum. The former were laid down by humanity's successors, evolved from rats, who had come to the discs as archeologists. And then come *their* successors, the descendants of neotenic dragonfly larvae, rapacious, blind, and fecund. Bram's humans flee to found a paradise in safety and repay their debt to the Nar.

It is a comment upon the condition of the bulk of modern science fiction that Don was able to astonish me with how little he relied on sci-tech gobbledygook. There is some, of course, but he has an amazing familiarity with the current state of science (he has to be a *Scientific American* subscriber!) and an even more amazing ability to use it all in the service of his story. He ducks some questions—how *does* the galaxy

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kill? How can the dragonflies sustain populations of trillions?—but by and large he is carefully and thoroughly imaginative.

Don is also relentlessly committed to rationality and, as much as possible in a predatory cosmos, to nonviolent solutions. His characters tend to be thin, but if they were not, we would have here a ten-volume magnum opus, and I am content without that expansion. It is enough that he has put himself in the front ranks of SF visionaries. Indeed, if he had written these novels in the 1940s, they would now be classics of *Foundation* caliber. They may yet be, though tastes have changed.

John Gilbert's first novel, **Aiki,** has many virtues—strong characters, an active plot set against a primal, good-vs.-evil background conflict, a touch of philosophy, writing that keeps the reader involved, even a vision of the 21st century that does not seem entirely unattainable. There are faults, too, and some are close kin to the virtues—blood, violence, and an utter cynicism that is never quite redeemed. Too, Gilbert's few women are weakly drawn. Whether you will like the book depends very much on whether you enjoy tales of intrigue and murder. It will probably appeal most to adolescent males.

Gilbert tells us that not too many years from now, the governments of the world will deliberately undermine sports, doing away with all concept of good sportsmanship or honor. Their aim is to replace boxers, wrestlers, football players, etc., with gladiators whose wounds and deaths will distract the populace from various problems and provide an ample supply of willing soldiers for "war games." They succeed so well that before long every major city has its coliseum, and street youths dream of achieving glory in the arena. Gilbert's vision is of a new Rome, declining in the decadent glow of the Circus Maximus.

The system is opposed by the disciples of an oriental guru, who espouse a philosophy of mental and spiritual balance, *aiki,* in the army and on the street. One of these disciples is Capitan, an underground master of martial arts, dedicated to the independence of the individual. Another is Mantis, who has perverted his guru's discipline and gained certain mystic powers after surviving the explosion of a "neutron grenade" (a bit of technical nonsense I find rather hard to swallow). He has become the undisputed lord of the arena, killing as he wills and destroying what little remains of the "sport's" honor. His aim is power, as absolute as anyone could dream.

Gilbert's tale is the events that bring these two men face-to-face in the arena. Along the way, he illustrates the impact of the new system through its effect on Bimbi, a street kid who has seen his older brother go down in a street fight just before he could embrace *aiki.* He fills in the background and posits a mechanism for reincarnation. He lets Mantis destroy Capitan's friends. And finally . . . Well the end is a foregone conclusion. Good must truimph, after all. But good's victories are never final, and Gilbert has prepared the reader to expect Mantis's continuance, perhaps for a sequel.

In his latest, **Star of Gypsies,** Robert Silverberg piles novelty upon novelty in a most frustrating way. I enjoyed it, but much less than I thought I should. Silverberg kept my hopes up, but ultimately he failed to satisfy.

Silverberg posits that the gypsies, the Rom, for all that they can interbreed

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with ordinary humans, are not human. They descend from refugees from Romany Star, a distant world that died when its sun flared; arriving on Earth, they build Atlantis, and when that land fell, they became wanderers. By the 36th century, long after the death of Earth, humanity dwells in a dual empire spread across hundreds of worlds. One empire is standard government, ruled by a dying emperor while three lords vie for the succession. The other is gypsy, presided over by the Rom baro, a ceremonial ruler and a settler of disputes between Rom and gaj; it arose when only the gypsies proved able to pilot starships with ease, and it is based largely on the economic dominance their talent gives the Rom. The gypsies have another talent, too: they can go ghosting, projecting their astral bodies into the past to witness events great and homely. They are wanderers indeed.

Star of Gypsies begins not long after the abdication of the Rom baro, Yakoub. He is vacationing on the frozen, uninhabited world of Mulano, companioned only by ghosts and spice fish, which swim in Mulano's ice, and he insists, even as he resists the entreaties to return of civilization's emissaries, that his retirement is but a political ploy. He has grown alarmed at his people's loss of dedication to the idea of returning to Romany Star, and he hopes to jar their gypsy spirit into awakening. But then comes word: his son Shandor, a monster of egocentricity, has taken the baro's throne. Yakoub must give up his ploy, return, and reclaim his throne. That done, he must do the best he can to settle the war of succession in the larger Empire, and then . . .

Yakoub's chosen path gives him a lot of time for reflection, on Mulano and in Shandor's dungeon, and Silverberg uses that time to display his life for us. He is nearly two centuries old, and he has lived through varieties of slavery, been a prince and star pilot, had wives and lovers, and received the kiss of destiny from ghosts of his future. His memories reveal a wondrous civilization and a technology that, though downright magical, seems curiously static. Yet, though Silverberg tries to convince us that Yakoub is a complex, subtle character, he seems much more a posturing opportunist. He fails to convince. Worse yet, though his story is repeatedly enchanting, its conclusion is predictable and the overall impression it makes on the reader is only a little more exciting than that of, say, the *Federal Register*.

Do I exaggerate? Well, then, I exaggerate. My point remains: *Star of Gypsies* has a lot of good material, but the whole, in this case, remains less than the sum of the parts. If you must have it, wait for the paperback.

According to L. Neil Smith in **The Wardove** the lunar survivors of Earth's destruction quickly split into two camps, one believing in individual freedom, the other believing in the power of the state. The former banished the latter, sending them off in a prototype starship to become the Cluster Powers and eventually make war on the good guys and their alien allies.

The story centers on a music group's tour of the allied worlds aboard a decrepit starship to raise funds and spirits for the war. The star of the show is Chelsie Bradford, and someone is trying to kill her with weakened staging, electrified mikes, suitcase bombs, and other deadly devices. And it is the job of Captain Inspector Nate Blackburn, gimpy nineteen-year-old hero of an early battle, to find that someone.

The result is a pedestrian tale that offers little to fans of SF or detective

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stories. The characters are unbelievably thin, with Blackburn much too old for his years and Bradford's beauty and emotive power constantly pointed to but never truly shown, and the plot resolution owes far too much to last-minute discoveries and far-fetched violence.

A Matter of Metalaw, by Lee Correy (G. Harry Stine), isn't much better. Here we have a far-future civilization, The Thousand Worlds, ruled by Metalaw, whose first principle is "Do unto others as they would have you do unto them." Conflicts are resolved by SIGNET's Agent Investigator Teams, groups of near-immortal humans of supposedly immense sagacity aided by intelligent starships and Bondian gadgetry.

The tale begins when Team leader Peter Starbuck, on well-deserved R&R (Raunchery & Ribaldry), feels the telepathic shock of another AI Team's extinction. His Team soon gets the assignment to investigate, and they find an outlying world suffering an unprecedented invasion by the dastardly Black Path of Thoth. They suffer loving torture, escape, track the villains to their home world, learn that they are in fact trying their best to live up to the Canons of Metalaw in their own way, and return to base, leaving the villains loose upon the cosmos.

Correy has a point: Metalaw is a grand ideal, but it has a serious weakness—what do you do with someone who likes to be hurt, or to someone who likes to hurt? How can sadists and masochists get along? What can sadists do when they run out of masochists? And Correy puts a lot of good stuff into his tale. His characters are more fully drawn than Smith's and his action more credible. Sadly, he also puts in a lot of tedious, moralizing, didactic lectures, the villains are strawmen, and the solutions to problems are too easy. Worse, he badly overuses the "If he had but known . . . " cliché of antique melodrama.

In the Ice King's Palace is Book 2 of A. Orr's *The World in Amber*, and if we find it somewhat less charming than Book 1, we can point to it as an example of the sequel that should never have been written. *Amber* was complete in itself, and it gained its charm from its audacious originality—it justified its fantasy by embedding a world, nay, a cosmos, like an ant in a lump of amber and filling it with medievaloid people, fairies, gnomes, wizards, and so on. And it was an excellent morality tale in the classic vein.

It must have been successful, or Orr would not have tried to repeat it. *Palace* reveals that Amber is a world in the grip of an ice age, with vast sheets of ice to the north, and that something is making the ice melt and the seas rise to threaten civilization. And it is the task of Isme, the new "wild sorcerer" whose magic comes only when the occasion demands it, to find a way to halt the thaw. Companioned by Wings, a lowlife thief, he sets off on a series of misadventures, eventually to learn the value and necessity of friendship and—of course—to succeed.

Palace is thus an entirely adequate fantasy, and it may very well please you. Unfortunately, Orr exhausted his originality in Book 1, and *Palace* is by no means the gem that was *Amber*. I suggest you save your money for something that will please you more. And yes, I do know that the gems are rare; that's what makes them special.

Seriesitis strikes again with Mark E. Rogers's **More Adventures of Samurai Cat.** Remember Miaowara Tomo-

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kato? "the finest warrior in all Japan"? "The awesome, the incorruptible, the invincible Samurai Cat"? When all the ages and worlds of pulp and film ganged up to slaughter his master, the samurai code dictated that he sally forth to seek revenge, and Rogers gave us a delicious send-up of bloody-minded action adventures, cute sidekicks, and super-heroes. Now he's done it again, as Tomokato continues his murderous quest into King Arthur's court, the Red Planet Bazoom, and the Empire State, where he must destroy the Deaf Star and its villainous masters, Cuomo and Shatner. He's still funny, but he is no longer fresh. Enough was enough, already. You can get as many yucks just by rereading volume 1; save your money for something new.

Or should you? It's a sad fact of life that good belly-laughs are scarce. Too often the only ones available on the stands are not belly new or not belly good. And half a laugh *is* better than none.

Blood River Down carries on its covers a handful of endorsements that must have made its author, Lionel Fenn, very happy. He tried to write a funny book, and several well-known writers said he succeeded. Unfortunately, the humor is the humor of the trivial, and if you remove that, there is precious little left except a weak imitation of the Tolkienesque quest.

The tale begins when Gideon Sunday, unemployed bench-warmer for a defunct football team, finds the back wall of his pantry replaced by a meadow. Fade to double take. Yock, yock. And then he must chase mysterious noises through his house to fine a woman who has called up the Bridge to his pantry in search of a hero who can help her find a duck and save the world. Then, armed with his super-weapon, a baseball bat, and handicapped by the disappearance of his summoner before she can tell him anything useful, he goes forth to eat the inedible, fall into holes, tame the untamable, team up with Iris (whose buttons refuse to stay buttoned), slay monsters, and confront a wicked sorcerer who is going to use the duck's down to destroy the world, and then eat the duck. And the duck is *really* . . . No, I won't tell you. If you buy the book, there should be at least one little surprise in store.

Eleanor Arnason doesn't reach quite so far for the yocks as Fenn, and her **To the Resurrection Station** is a little more successful. She evokes mild laughs by pushing the coincidences proverbial with gothic romances to extremes of ridiculousness, and by positing that her heroine, Belinda Smith, has a freak psi talent, derived from her native forebears, that casts around her an improbability field, so that she and her fellow characters undergo the strangest of transformations. Yet that is not enough. Her characters are thin and her realities arbitrary, and an author can get away with such things only when the humor is broader. Mild humor needs more support.

New Hope is a colony world settled by refugees from an Earth threatened by overcrowding, pollution, and imminent war. It has natives, too, and when Belinda is yanked out of college by her alcoholic guardian, Geoffrey, the last of the Hernshaws (the first of whom, Godfrey, commanded the colony ship centuries before), she learns that she is a hybrid human-native, the child of the late Gilbert Hernshaw. Worse yet, she was destined at birth to marry a native, Claude Alone-in-the-Forest, and she loves another—her roommate, Marianne.

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We soon learn that Claude also loves another, and that that other is none other than his beloved Marianne! Happily, the ancient retainer, robot No. 39, recovers its memory to recall that Godfrey Hernshaw, before his death, transferred his mind into its memory banks. And there is a spaceship entombed in the bowels of the moldering Hernshaw manse. Robot, Belinda, and Claude flee, bringing the manse down around Geoffrey's ears. When they land elsewhere on the planet, they learn that Marianne's secret husband has just returned from the jungle, and they flee again, this time to Earth.

Unexpectedly, the centuries have cleansed Earth's air, but humans are few and far between, thanks to a war with an alliance of robots and engineered intelligent rats. However, traces of the old technology remain, and they hear of a Resurrection Station, where failing bodies—perhaps even those of robots—can be replaced with new.

At the end, Belinda and her friends, with a novel addition, are back aboard the ship, heading off for new adventures. I suspect a sequel is in the works, but I was not sufficiently enchanted to look forward to it.

As I write this in October, the first books for Christmas 1986 are appearing, typically glossy, colorful, and overpriced, like the trade paperback **Futuredays.** It is a collection of fifty cigarette cards quaintly portraying life in the year 2000, commissioned for the 1900 centennial in France but never released because the company went out of business. A set of the cards turned up in the vacant factory in the 1920s and was bought by a collector. And eventually, we get this book, introduced with an Asimovian essay on futurism and fleshed out by the cards themselves, each one accompanied by Isaac Asimov's comments, generally poking gentle fun at the shortsightedness of the artist, one Jean Marc Coté, but giving full credit whenever he came near the mark.

Asimov carries more at the top of his head than many writers can manage after six months' research, so it is no great accusation to say that his prose here seems to have been written off the top of that bulging brow. More to the point may be the reason for such writing, and the other evidence for that reason. I suspect the book was put together in some haste, and the evidence is that Asimov apparently did not or could not take the time to study the cards carefully before he wrote his commentary. The case in point is the card on page 46, titled "A mistake on the job," in which a hunter stands aghast as an aviator falls from his plane. Asimov gives the artist credit for predicting "pilot error," failing to note the smoke issuing from the hunter's gun. The mistake seems to have been not the pilot's, but the hunter's, who mistook the plane for a duck and shot it down, and perhaps the artist should be credited with predicting antiaircraft fire.

Futuredays is one of those books you won't want to buy for yourself. But someone who knows you like SF may think it just right to put under your tree. If so, you will surely enjoy its quaint charm.

"It's been a long-staggering tradition in science-fiction stories that space pirates, interstellar adventurers, and the Galactic Patrol all stop by the spaceport bar for a quick one before heading out to the untamed reaches of the void. . . . " So say George H. Scithers and Darrell Schweitzer in the preface to their anthology, **Tales from the Spaceport Bar,** adding that the SF bar story first emerged from a long main-

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stream background with Lord Dunsany's tales of Jorkens and the Billards Club. Today, it is a cliché vehicle for tall tales. Yet among the clichés lie buried a number of memorable yarns, from those of Spider Robinson's Callahan's Place to Pratt's and de Camp's Gavagan's Bar to . . .

You will find a sampling of the best in this anthology. There is a Jorkens tale, a Gavagan's, a Callahan's. There is one of Larry Niven's Draco Tavern tales, another from Janet Jeppson's Pshrink's Anonymous, still another from Isaac Asimov's Union Club, and one from Arthur C. Clarke's White Hart. There are tales by Kuttner, Dozois, Lafferty, Barnes, St. Clair, Davidson, Silverberg, Budrys, and more. there is even Zelazny's "Unicorn Variation."

Yet not all is wine and gumdrops. Grendel Briarton contributes a weak piece of Feghootiana, Schweitzer offers a particularly feeble limerick, and Barry Longyear, John M. Ford, and Scithers perpetrate an atrocity ("What's Wrong with This Picture?") whose only excuse is to cram into a small space as many SF in-references as possible. And the editors have chosen to play cute by capitalizing all the varieties of Booze mentioned in the stories.

Still and all, it's a fun book. Every serious bar-goer should have a copy. ■

ON GAMING

(continued from page 129)

recorded both on your phaser and on your chest sensor, and all the systems are connected by durable wires. *Photon* is a bit more expensive, but it's worth it.

Now, having settled that weighty issue, you can consider adding *Photon* to your arsenal of modern home entertainment conveniences. Undoubtedly, you might indeed look funny skulking around your neighborhood, *Photon* phaser in hand, helmet blinking on and off like a Christmas ornament, stalking some other goofy uninhibited soul.

But, on the other hand, if you can find a secluded place (a park, perhaps, or a friend's backyard) I'm sure you'll feel a bit like that eight year old we all once were. You'll be dodging, ducking, and diving while every cliché move from a space opera runs through your mind. The home version of the game is as good as the *Photon* franchise. No, maybe it's better when you think that you can play this game anywhere.

Photon also includes a rule book offering a variety of games, most based on turning and firing with a judicious use of your shots. What I'd really like to do, though, is get twenty like-minded folk together with their handy-dandy *Photon* sets, and stage the climactic battle on Endor at some abandoned warehouse.

Entertech has done a great job translating *Photon* into a mass market game that plays as well as the franchise experience. And while your bones may creak and your muscles ache after a bout of twisting and rolling on the ground, I recommend *Photon* as a high-tech version of "kick the can"—guaranteed to make you feel young again. ■

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brass tacks

Dear Dr. Schmidt,

I would like to respond to Mr. Brian L. Burley's letter which appeared in the November 1986 "Brass Tacks." In that letter Mr. Burley equated intelligence with the ability to survive in one's environment. I submit the following argument:

Premise 1: The ability of an animal to survive in its environment as well as humans do in their environment demonstrates the intelligence of the animal.

Premise 2: The amoeba has survived for an extremely long time.

Conclusion: The amoeba is an intelligent animal.

A logician would refer to an argument of the above type as a reductio ad absurdum. That is, the premises lead to a conclusion which is absurd. In such a case, one must either accept the absurd conclusion or throw out one or more of the premises.

I think that Premise 1 correctly restates Mr. Burley's argument, and I assume that he would not challenge Premise 2. Thus, unless Mr. Burley is willing to accept the amoeba as an intelligent being, he is going to have to rethink his viewpoint.

MATTHEW CANFIELD
13841 Via Rimini
San Diego, CA 92129

Dear Mr. Schmidt,

The article about the possible humanoid face on Mars and your editorial about people's reactions to the idea (November 1986) reminds me of an incident when I was a freshman physics major at the University of Chicago in 1975. I came across an article in *Physical Review Letters* by a researcher in a small college who had done an experiment to test for variations in the gravitational constant g over distance,

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and reported such a dependence. I told a classmate of mine about the article in order to discuss the ramifications to physics if that result was confirmed.

My classmate turned to me with a look of disgust and said, "You don't actually believe this, do you?"

I was so embarrassed that I tried to completely forget about the article. That is, until the Alternate View column on a possible fifth fundamental force (September 1986) that resembles gravity but is repulsive and short range. Just maybe, that researcher *had* measured a real effect (the fifth force) in his experiment, but simply drew the wrong conclusion from it.

How many people are like my classmate when a revolutionary idea is presented? And how many people back down like I did when they want to investigate such ideas but receive ridicule? Richard Hoagland should be commended for his courage in investigating and *presenting* his case for a humanoid face on Mars. The rest of us owe it to him, and ourselves, to keep an open mind.

JOSEPH H. ULOWETZ

Lombard, IL

Dear Stan,

Thanks for a great November issue! I've been reading *Analog* regularly since before I was born, and the current one is as thought-provoking as the best of them. (Since before I was born? Of course—my father has quite a collection.) *Analog* tends to open up my horizons once again after they have been brought in too close for comfort (close horizons can be awfully discouraging). I only wish you could publish a larger magazine, so that I wouldn't be able to finish it in one evening, or at least publish more often.

Anyway, now down to the meat of this letter. Your editorial on "Cold Feet" (November) is interesting, but I'm not sure that's exactly what is causing the denial of the "Face at Cydonia." I believe your reply to D. J. Elden's letter (Brass Tacks, November) in which you stated, "Yes, it is the words that guide the reader—along with a whole set of his own explicit or implied assumptions," is closer to actuality.

If there's one thing I've learned from reading and working in user interface design, from watching how some parents react to their now-adult offspring, and from relations with one of my best friends—it's that people generally see or fail to see exactly what they expect no matter what the facts. Just as a computer user will form a conceptual model of the system he or she is using, people form models of their world. One pitfall in this system is due to "relevance bias." In selecting what information to pay attention to, people have to make judgments of relevance. The alternative is to be swamped with excess information. The problem arises from the fact that such judgments of relevance are based on what one thinks is happening, and that is determined by the person's conceptual model. People thus interpret things in a way that fits with what they already expect!

This sort of thing can lead to some very interesting errors in computer system usage. (A fire alarm once went off when a lady, who was using a computer for the first time, also received a cryptic error message on her screen. She was convinced that she had caused the alarm—perhaps the computer had caught fire—and fell all over herself to apologize.) In addition, this problem can lead to adults who come home from college being treated as children by their parents (because their parents expect or even want them to act like children, and

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thus interpret all actions in that manner). It can also lead to friends thinking that you're a nasty person (since they expect that "you're always looking for something to complain about") after listening to someone else lie about you behind your back long and loud enough. Some general terms describing this, "set" and "functional fixation," come from psychology, but my favorite and possibly the most accurate is "cognitive hysteresis" (it takes less information to reach an interpretation than it does to change that interpretation). Regardless, those terms are all fancy ways of saying that people interpret what they see as what they expect, and their expectations are thus reinforced.

This can apply many ways to the "Face on Mars." On the one hand, certain people, once they had heard of it, could expect to see a humanoid face. On the other hand, some of our well-known scientists have spent much effort and a large part of their lives tied up in believing that radio frequencies will be the means of contact with any possible extraterrestrial intelligences, and thus anything else doesn't fit their models.

The fact that I saw the enhanced picture on page 64 of Mr. Hoagland's article before I had looked at the title of the article, or even the table of contents, argues against the first view. Until I looked at the caption on the previous page (and saw the words "NASA Viking frame . . . ") I actually had jumped to the conclusion it was part of an article on the new archaeological finds made with remote sensing here on Earth. Since I have seen such pictures of archaeological sites in the past, I interpreted what I saw in a way that was familiar to me. Regardless of *where* I thought it was, even without prior knowledge it looked at first glance like a face to me.

Judging by the history of physics, and science in general, I think the general tendency of scientists to become dogmatic about their theories and hypotheses makes the second case above even more likely. It was once said that new advances in physics cannot occur until the people who generated the currently popular version of the world have died or retired. That is sadly accurate, and applies to many sciences, not just physics. Preconceived notions about the way the universe is tend to persist even in the face of data that, to one without the same preconceptions, seem to contradict those notions. Add scientific egos to cognitive hysteresis and you get some awfully closed minded people.

(Here's a real-time example of cognitive hysteresis: Those who expect me to be denouncing scientists as closed minded dogmatists, or who have a strong feeling about such issues, will see exactly that in the last sentence of the above paragraph. As a result, some will nod in jubilant agreement with my sticking up for the non-traditional and the underdog, and others will be darkly upset at me for unfairly maligning many good people. Phooey to both.)

As a result, I am generally skeptical of any pat pronouncements, whether they come from someone with a scientific reputation or not. If the issue is important to me I have this annoying tendency to demand to see the data so I can decide for myself. Since the data we have on the "Face" is *very* suggestive but still somewhat sparse, I believe we need to return SOON to Mars in order to find out exactly what there is at Cydonia.

RICHARD JOHNSON

Boulder, CO

Dear Stan,

There's an aspect to this Martian Face

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business that I haven't seen discussed in any of the several articles I've read about it, including Richard Hoagland's November fact piece ("The Curious Case of the Humanoid Face . . . on Mars") as well as your own editorial in the same issue.

The thing is, seeing faces is one of the commonest of visual illusions. We're always finding faces in clouds, in old linoleum, in lunar maria, even in automobile headlights. This phenomenon has become almost a cultural cliché, with all manner of inanimate objects assuming anthropomorphic features in cartoons.

Why faces? Well, it seems there's an area of the brain, in the right temporal cortex, specialized for just this purpose. When this area is damaged, a disorder results called prosopagnosia: the partial or complete inability to recognize human faces, even those of one's most intimate friends. There's a classical experiment, performed by Hans Teuber, in which a prosopagnosic was shown a crude cartoon sketch of a face; the patient failed utterly to identify it as such, calling it an apple instead. (Interestingly, the sketch in question, as reproduced in Carl Sagan's *The Dragons of Eden*, bears a striking resemblance to Hoagland's Figure 2.)

What this experiment reveals is that marks on paper have no intrinsic "faceness"; it is our minds that construct a face from those marks. Likewise, the rock formation that Hoagland calls "the Face" is in itself no more than a big chunk of rock. Any faceness it has exists only in our minds. And this is so whether the formation is a trick of nature or, as Hoagland suggests, an artifact of alien intelligence.

So it seems to me that Hoagland's hypothesis requires not merely a race of intelligent humanoids right next-door in the geologically recent past, but also a single criterion of faceness sensible both to us and to them, despite differing evolutionary history and brain physiology. The aliens must not only look like us, they must *see* like us as well, in exactly the sense most intimately tied up with our racial identity: our ability to recognize each other as individuals. Either that, or else the architect of the Face must have been human, or had human consultants, at a time when the most nearly human face on Earth belonged to slope-browed, chinless *Homo erectus*.

None of which disproves Hoagland's ideas. However, let's not forget that there is a substantial leap of imagination, albeit an unconscious one, between the (to be blunt) rather crude pictures returned by Viking and the lifelike image of a Face we hold in our minds. To suppose that an alien mind will make that leap in precisely the same way seems to strain the bounds of probability at least as much as the "freak of nature" hypothesis Hoagland disparages.

GREGORY KUSNICK

Dear Stan,

Some comments on the "face on Mars" controversy detailed in *Analog*'s November 1986 issue: I sympathize with the "Popperian" ideal that you advocate; scientific communities ought to openly and objectively seek counterexamples to existing hypotheses, and accept as knowledge only those propositions that survive such tests. That this does not happen is no mystery. Two behavioral premises may underlie the attitudes of those who cursorily dismiss the face with banal or defensive explanations.

First, the "culture" of science has traditionally been far more consensus-

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oriented than individuated and antagonistic, and revolutions in scientific perception have been actively resisted longer than good practice would merit. I cite the Copernican revolution and the debate over black body radiation as examples. Students accept prevailing paradigms through rote experience, and maintain their predispositions in their professional careers through fraternal socialization and a highly-developed system of social controls. Personal interests, the selection of significant phenomena, research and theory are often determined by the paradigm. Counterexamples are actively resisted, and not always for logical reasons. Frequently a personal *Weltanschauung*, or worldview, is at stake.

Second, the face itself is not the kind of phenomenon that normally rewards research. Consider the benefits to a group of physicists, geologists, and planetary astronomers who elect to spend time and resources looking into the problem. If the face is a mere geological formation, then it will be of little interest on a planet of extraordinary features like Olympus Mons and the Noctis Labrynthis. If the face is an artifact, physics, astronomy, and geology may provide tools to gather data, but ultimately the definitive interpretations will fall within the methodological and philosophical realms of anthropology and history. While I am not claiming that physical scientists are incapable of grappling with these disciplines, I do suggest that they could feel distinctly uncomfortable with the synthesis of methods necessary to obtain an understanding of such an artifact. Hence, the normal resistance to investigating an unorthodox phenomenon is multiplied.

Well then, what to do? I am only an historian with an abiding interest in the relationship of science to society, and therefore any technical solutions I could propose would be amateurish. With that disclaimer out of the way, let me make a suggestion.

Obviously, more information is needed. Obviously, the only way to get that information is to return to Mars. Obviously, the critical problem of getting back there is not technical, but social. An influential group of scientists needs to be convinced that the face provides a respectable priority for investigation, and the media and the public need to be informed in a manner that does not invite ridicule. At all costs a public relations disaster must be avoided, for it will not only alienate key personnel who are rightly concerned about the destructive potential to themselves and their research, but it will also alienate the public, who, after all, will have to pay for the project. Imagine what William Proxmire or the *Washington Post* would make of the idea, in this era of deficits and eroding social programs, of mounting an expensive manned mission to Mars to look at a funny rock. Never mind that the same expedition would gather invaluable information about many other priorities. The face on Mars would be hyped as the symbolic metaphor for such an endeavor. Waning public interest after the Viking landers' inability to definitively find microbal life in Chryse and Utopia is a milder example of the potentially negative reaction to what could be perceived as failure.

On the other hand, if the face turns out to be a genuine artifact, widespread public support is certainly forseeable. But how can the risk be minimized?

It might be possible to mount an inexpensive, underpublicized, unmanned mission, something quite crude by present standards. A low-orbit vehicle with high-resolution cameras would be necessary, along with camera-equipped

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capsules that could survive entry into the Martian atmosphere, deploy parachutes, and drift over the Cydonia region. These capsules need not soft-land; like the Ranger series, they could transmit a few minutes of data before crashing into the surface.

Such a mission would have several advantages. First, it is not a high-profile, expensive venture, and therefore is relatively low-risk in terms of budget and public perception. Second, since the face and nearby structures are suggestive even in the Viking data, a number of high-resolution photographs from a range of several kilometers at different times of the Martian day may provide enough convincing evidence one way or the other. If the evidence tends toward artifacts, it should be enough to warrant a manned expedition. But if, when the first or second capsule drifts over Cydonia, the face is found to be nothing more than a "trick of light and shadow," the remaining entry capsules could be programmed to deploy across other regions. The mission, therefore, would not be a complete disappointment, and a stigma might be partially avoided.

I realize that this suggestion is tantamount to a mild game of subterfuge. After all, the mission's principle priority would be downplayed unless a "positive" identification is made. But the alternative is a long and perhaps fruitless debate. Too often, in science as well as in other worthwhile pursuits, curiosity is obstructed by a shallow assessment of short-term benefits. Rarely can we conceptualize convincingly beyond the immediate gains to ourselves and perhaps our children. When we do, frequently the gains must be material in nature to provide the impetus necessary to take risks. Too bad. If Mr. Hoagland's speculations are correct, then the face can give to humanity gifts that are perhaps intangible, but no less important—maturity, a wider perspective, a firmer foundation upon which to judge the meaning and value of life. Of course, the same benefits could come from the interception of radio transmissions currently paradigmatic in SETI theory. But I have seen very little attempt on the part of those interested in these kinds of problems—scientists, mostly—to articulate publicly just what the benefits of finding other intelligent species are. Until such a useful debate is engendered in the public forum, pathetic suggestions similar to mine are likely to remain the only "safe and sane" method of investigation.

JOSEPH MANZIONE

Dear Editor,

I know how much you like nitpickers, but I write you this letter regardless. The November *Analog* illustration for the article "The White Hope" has what was meant to be the Rod of Aesculapius but is actually the Caduceus of Hermes. The rod is the familiar symbol of medicine, and has a single snake entwined about a staff. The Caduceus has two snakes, and is the symbol for trade and commerce.

D.C. SPEIRS

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Calgary, Alberta
Canada, T2P 2E7

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a calendar of analog upcoming events

5-7 June
NEO-VENTION VI (Ohio gaming convention) at Student Union, Kent State University, Kent, Ohio. Info: NEO-GS, Box 412, Cuyahoga Falls OH 44222-0412. Include S.A.S.E.

5-7 June
LEPRECON 13 (Phoenix area SF conference) at Hyatt Regency, Phoenix, Ariz. Guest of Honor—Raymond Feist, Artist Guest of Honor—Phil Foglio, Fan Guest of Honor—Susan Potter. Info: Leprecon 13, Box 26665, Tempe AZ 85282. (602) 968-5749, 839-2543, 968-7790.

6-8 June
NEXUS '87 (Missouri SF conference) at Howard Johnson's, Springfield, Mo. Guests Ben Bova, Frederik Pohl, Melissa Scott, Fan Guest of Honor—David Means. Registration—$12.50 until 1 May, $15 thereafter. Info: Nexus '87, Box 1734, Springfield MO 65805.

11-14 June
DEEPSOUTHCON 25 (Southern regional SF conference) at Huntsville Marriott, Huntsville, Ala. Guest of Honor—Robert Bloch, Special Guest—Hugh B. Cave, TM—Ramsey Campbell, Artist Guest of Honor—Phil Foglio, Fan Guest of Honor—Lee Hoffman. Registration—$20 until 17 May, $25 thereafter. Hotel is on grounds of Space & Rocket Center Museum. Info: DeepSouthCon, Box 4857, Huntsville AL 35815. (include S.A.S.E.)

12-14 June
AD ASTRA 7/CANVENTION (Canadian SF conference) At Howard Johnson's Airport Hotel, Toronto, Ont. Guests of Honour—C.J. Cherryh, E. Vonarburg, Fan Guest of Honour—Diana Gallagher. Registration—C$15 until 15 May, C$20 at the door. Info: Ad Astra 7, Box 7276, Station A, Toronto, Ontario, Canada M5W 1X9.

19-21 June
OZMAPOLITAN (Oz conference) at Zion, Ill. Info: Fred N. Meyer, 220 North 11th, Escanaba MI 49829.

27-28 June
READERCON (Literary-oriented Boston SF conference) at Holiday Inn, Brookline, Mass. Writer Guest of Honor—Gene Wolfe, Publisher Guest of Honor—Mark Ziesing. Registration $5 supporting, $10 attending. Info: Readercon, Box 6138, Boston MA 02209.

27 August-2 September 1987
CONSPIRACY '87 (45th World Science Fiction Convention) at Metropole Hotel & Conference Centre, Brighton, U.K. Guests of Honour—Alfred Bester, Doris Lessing, Arkady and Boris Strugatsky; Fan Guests of Honour—Joyce and Ken Slater; Artist Guest of Honour—Jim Burn; Special Fan Guest—David Langford; TM—Brian Aldiss. Registration—Attending £25, $50, $A50; (given the exchange rates people joining from the U.S. should consider tendering payment in British or Australian money). Child Attending £12.50, $25, $A25; Supporting £10, $15, $A20. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition, the works. Join now and get to nominate and vote for the Hugo awards and the John W. Campbell Award for Best New Writer. Info: ConSpiracy '87, Box 43, Cambridge CB1 3JJ, England, U.K. OR Bill & Mary Burns, 23 Kensington Court, Hempstead NY 11550 OR Justin Ackroyd, GPO Box 2708X, Melbourne, Vic. 3001 Australia.

—Anthony Lewis

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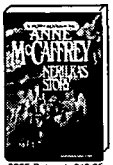

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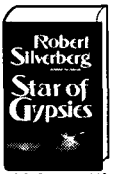

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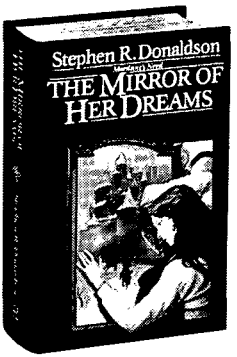

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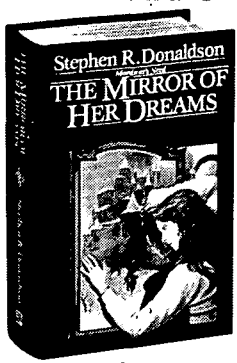

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